MINIATURE CAMERA TECHNIQUE

By
FENWICK G. SMALL

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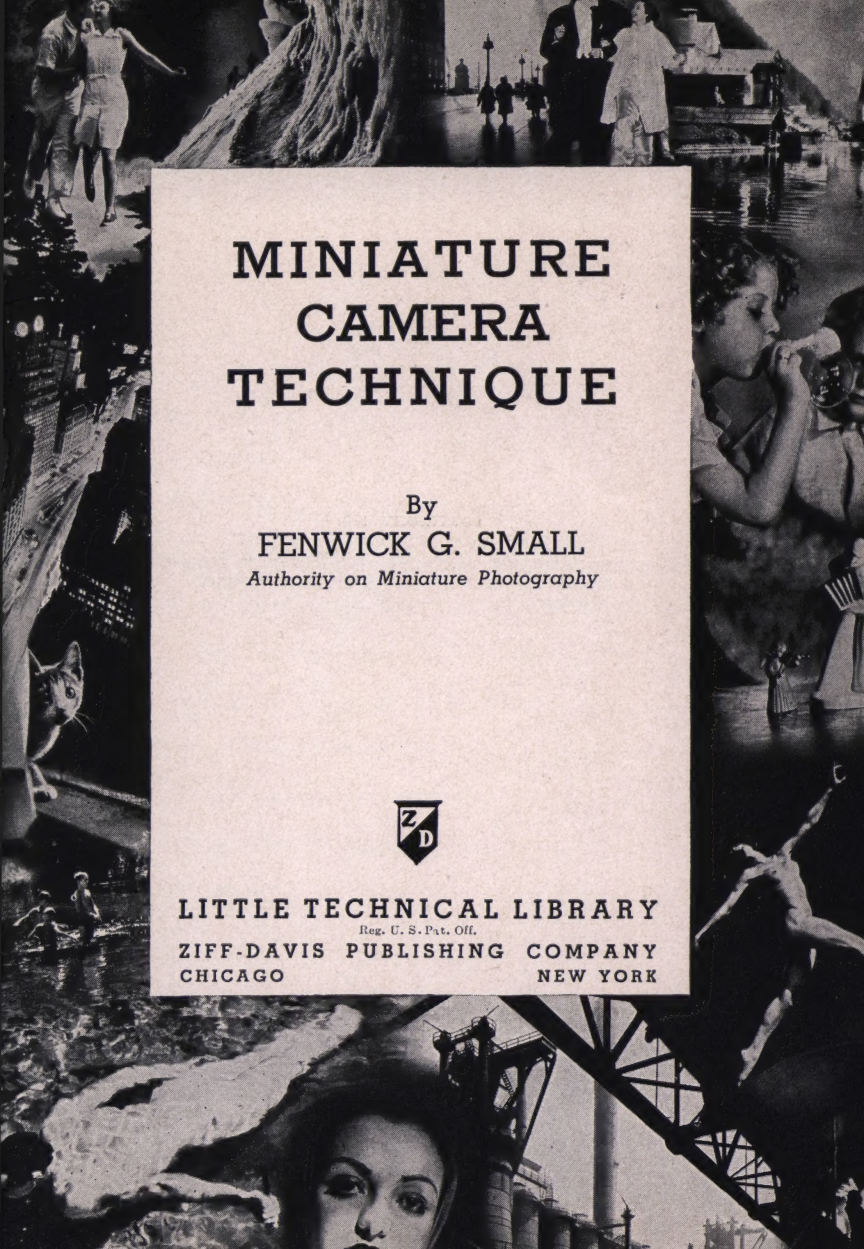

MINIATURE CAMERA TECHNIQUE

By
FENWICK G. SMALL
Authority on Miniature Photography

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HOLLYHOCK

By Fenwick G. Small

CHAPTER I

INTRODUCTION

Why the Miniature?

Over the last ten years the miniature camera has carried photography, both as a hobby and a profession, to a new high in popularity. People are using miniatures everywhere for fun, profit, or as adjuncts to their hobbies, sports, businesses, or professions. An impartial survey, conducted last year by a photographic publisher among advanced amateur and professional photographers, indicated that more than 85% of those queried were using film sizes 2½"x3½" (6.5x9 cm) or smaller.

The foremost advantage of the miniature is convenience. It is small and compact, easy to carry, and easy to use; the controls are all close together under the finger tips. It can be brought into action quickly, regardless of position or angle; it attracts less attention and can be used under circumstances that prohibit the use of the larger camera. With this combination, the miniature photographer gets pictures impossible for the large camera owner to secure.

The small negative size of the miniature permits the use of lenses of short focal length. With the long-focus lenses of the large-negative cameras, the distance before and behind the point on which the lens is focused that will be sharp in the negative (called the depth of field) is less at the same aperture than with the short-focus lenses of the miniature. Greater depth of field can be secured with any lens by closing the aperture, but then less light is passed by the lens. The lens diaphragm of the large camera, therefore, is frequently set at such a small aperture that the camera must be placed on the tripod for a time exposure. The same depth of field can be had with the diaphragm of the short-focus lens of

the miniature opened to such an aperture that split-second exposures can be given and the camera held in the hand.

Quality for quality, lens speed for lens speed, the miniature costs less than its larger brothers. The widely-advertised cost of some of the ultra-precision miniatures may make this statement seem improbable. A comparison in the miniature size itself shows that the 2¼"x3¼" camera of one manufacturer costs $30, while a smaller-negative-size camera of the same manufacturer, with the same type lens and shutter equipment, is $22.50. In the less-expensive class, the same manufacturer's 35 mm camera is $14.50, while a 2¼"x3¼" camera of the same quality with a similar shutter and slower lens costs $17. And the economy is continued in its film cost, especially to those who make many exposures of a single subject.

Is the Miniature New?

The miniature camera itself is not new, although its present popularity is. Fox-Talbot, the man who first produced photographic images on paper, found in 1835 that more rapid exposures could be given where small cameras with short-focus, large-aperture lenses were used. Joseph Nicephore Niepce, sometimes credited with having discovered photography (although his process was of little practical value), in 1816, used a camera that made a circular picture about 1¼" in diameter. Ever since these early beginnings, photographers have wanted small-size cameras on account of their many advantages. These were more than offset by the many disadvantages of the early miniatures. Practically all were made as small versions of the larger cameras. Many were badly constructed, and enlargements from their small negatives were in no sense comparable with those of the same size from the larger negatives. Films did not have the necessary fine grain and color sensitivity, and the developers used were of the highly alkaline type that seems to excel in producing grain—the bane of the miniature worker.

For miniature photography to become accepted by the many who would be interested, precision-built cameras and enlargers, high-speed lenses with good definition, fast finegrain films, and improved, finegrain developers were needed. Since errors in exposure and focusing constituted about 90% of the amateur's mistakes, guesswork had to be eliminated if the high-speed lenses were to be used at their largest apertures. With many manufacturers concentrating on them, most of these problems were solved in the ten-year period commencing with 1924, and the miniature became a practical tool instead of the experimental toy it previously had been. By 1934 enlargements of incredible proportions were easily possible to any careful worker. From then on, with the improvement of materials and the introduction of low-priced miniatures, the swing to this kind of photography grew like a snowball going down hill. After so many years, the miniature finally had arrived.

MANDARIN DUCK, by Dr. Ernst Schwarz, is an illustration of the use of the miniature for records in the field of natural history. Taken with a Contax with *f* 6.3 telephoto lens on Supernan film; 1/125 second exposure at lens stop of *f* 6.3.

What Is a Miniature Camera?

The accepted standard for a miniature camera was the subject of much controversy. At the start of their present popularity, many insisted that only the miniatures using 35 mm motion picture film qualified. Others argued that the same problems applied to the half vest-pocket size (3x4 cm), the 1⅝" (4x4 cm) square size, and the 1⅝"x2¼" (4.5x6 cm) size of the vest-pocket camera. As a matter of fact, the physical dimensions of some of these cameras using the larger negative sizes were smaller than those of the 35 mm cameras which produced negatives measuring 1"x1½" (24x36 mm). With the eventual realization that the required enlargement of the negative rather than the size of the camera, its manner of construction, or its method of operation was the decisive factor, general agreement was reached that 2½"x3½" (6.5x9 cm) would be the demarcation line between the sheep and the goats. This was based on the fact that this negative size, assuming that the entire negative area is hardly ever used, generally required a minimum of five times enlargement to secure an 8"x10" print. This is the generally accepted standard today.

Is Miniature Photography Different?

Yes and no! In the selection of tools—cameras, lenses, enlargers, accessories, etc.—the user of the miniature has a wider selection. The cameras have a wider field of application, and many things that would be missed with the large camera will be caught with the miniature. Different and more careful procedure is required as far as negative development is concerned. The negatives must be handled more carefully; they cannot be retouched to the same extent as the larger negatives, and dust is more disastrous. Basically, there is no difference. The miniature user must observe a greater degree of care and cleanliness in his work. If the right working habits are adopted at the start, no undue hardship or difficulty should be encountered. As a matter of fact, because care and cleanliness give better results, many users of

PIROUETTE OF THE SEA, by Joe Weiner, A.R.P.S., is an outstanding photograph of the seashore, with good exposure and depth of field. Taken with a Super Ikonta B with *f* 2.8 lens on Panatomic film; the exposure was 1/50 second at a diaphragm setting of *f* 6.3.

large cameras are following the lead the miniature workers have been compelled to set.

Is Miniature Photography Difficult?

Yes and no again! Given the same amount of study and practice you would devote to learning how to drive a car, the making of good pictures can be learned in a short time. Their pictorial quality will depend, of course, on your ability to see a picture and to translate on paper what you see. That ability you will acquire in time. Photomicrography, medical photography, or any of the specialized applications of your miniature will require a greater perfection of technique and a knowledge of the particular field in which the camera is being applied. No great difficulty will be encountered, however, in learning how to make clear, brilliant enlargements. A little practice and the observance of the major principles—care and cleanliness—are all that is required.

CHAPTER II

YOUR MINIATURE CAMERA

Its Selection.

There is a bewildering variety of excellent miniature cameras from which to choose. Both the advice of your dealer and the aid of an experienced friend will be valuable. Their suggestions, naturally based on personal inclinations and enthusiasms, should be modified, however, by an analysis of your own preferences. For this purpose, the many miniatures advertised in the magazines and displayed on your dealer's shelves can be divided into several classifications (folding roll film, reflex, 35 mm, and plate and filmpack) each of which offers certain advantages. Although some will be better adapted to certain conditions, any of them can be used successfully for general photography. Unless your interest lies in one of the fields requiring a specific type, choose the one nearest your personal preferences in design and operation. The use to which you are going to put the camera and its ease of operation are the important considerations.

The decision will be easier if your choice between the reflex, generally used at waist level, and the other classes, more conveniently used at eye level, is made first. Either type can be used like the other with a supplementary finder, fitted to some cameras and available as an accessory for others. Your miniature will be more versatile with a supplementary finder, but it is generally used only when camera position requires it. Therefore, consideration should be given to the relative advantages of each type.

Your choice between eye level and reflex decided, you must make up your mind as to negative size—another widely-debated question among miniature workers. Both types are available in all sizes from 35 mm to the maxi-

mum of 2½"x3½". The swing a few years ago was to the 35 mm size; today many are favoring the larger sizes with the eight-exposure 2¼"x3¼" roll film the most popular. This size is most generally used by advanced workers in roll-film or reflex cameras producing eleven or twelve 2¼"x2¼" negatives to a roll.

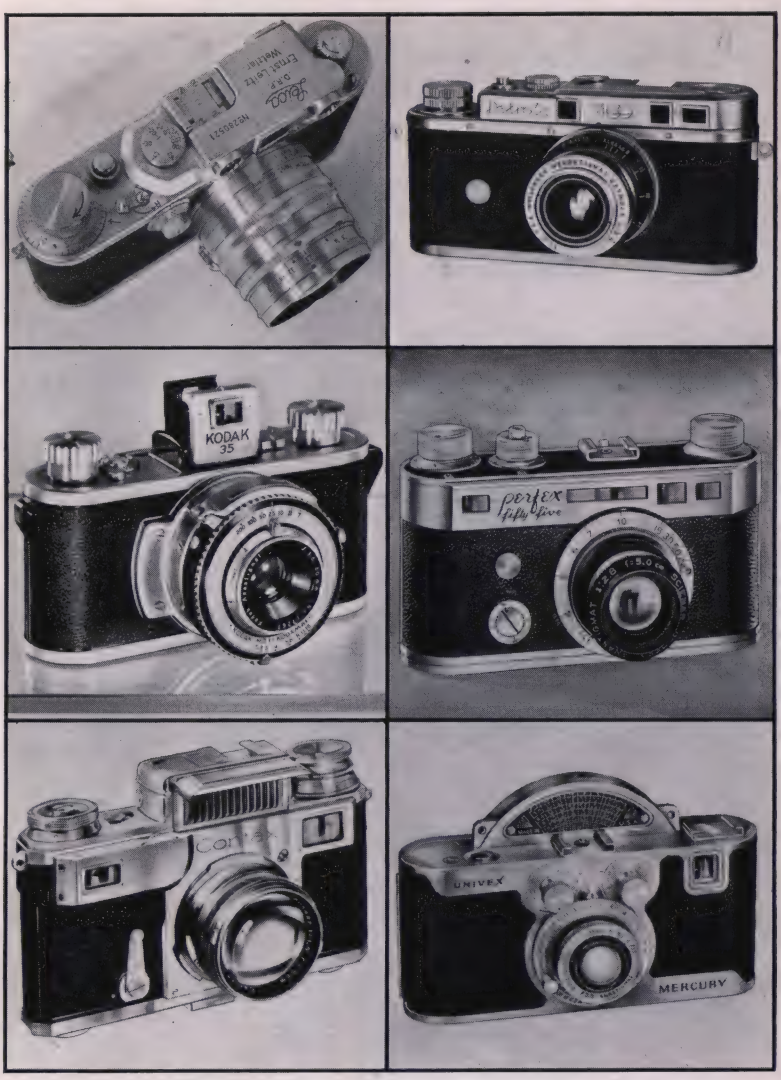
All negative sizes are being successfully used, however, for general photographic work. The smaller sizes require a greater degree of care than the larger, but the continual introduction of new films with finer grain and greater speed is eliminating this difference. The 35 mm film, if purchased in bulk, is more economical, but the tiny negatives must be enlarged, even for album use. Good workers today are producing very fine 8x10 and 11x14 enlargements from negatives of all sizes. The choice of negative size is one that you must make yourself.

The 35 mm Miniature.

Extreme compactness, utmost economy in film expense, and the great depth of field of their lenses are the main advantages of the 35 mm miniatures.

With accessories, they are, perhaps, the most versatile cameras made today—more complete in application in all fields. They are not necessarily expensive, selling from $15 up. Although the more expensive models naturally offer a wider selection of accessories and lenses, better quality, and a greater convenience in use, excellent work can be done with the less expensive models. But, if you cannot afford one with interchangeable lenses and accessories, yet prefer the eye-level type, and if you plan to use black-and-white film in preference to color, the slightly larger roll-film camera will be the better choice.

The so-called "sequence" cameras are another development in the 35 mm size. Having either a clock-work mechanism or lever action that resets the shutter and winds the film after exposure, a great number of exposures can be made with them in a very short time. They are excellent cameras to use with children or where many pictures are desired of one sequence of action. At close



A group of miniature cameras typical of the 35 mm classification.

distances with rapidly moving subjects they are ideal because many pictures can be taken in rapid succession without removing the camera from the eye to wind the film or set the shutter. Their negative size is 1″x1″, and the photographer who does not make big enlargements from his negatives will find greater economy in their use, especially with color film. Some of the standard 35 mm miniatures can be converted into sequence cameras by the addition of an accessory clock-work or lever mechanism that operates in much the same manner.

The Folding Roll-film Miniature.

Most popular in this country for many years, it is only recently that folding roll-film cameras have offered advanced amateurs the advantages of some of the other types. These cameras are compact and easily handled; film for them is readily available anywhere, and the more expensive models have many of the advantages of the better 35 mm miniatures. Those desiring a camera of the eye-level type for black-and-white work will find them more advantageous than many of the 35 mm miniatures with non-interchangeable lenses. The more expensive models are fitted with fast lenses, interlocks to prevent double exposure, and lens-coupled rangefinders of both the dual and twin-eyepiece types. Some have built-in photoelectric exposure meters, and in one of them the meter is coupled to the diaphragm so as to provide automatic setting for the correct exposure.

Cameras in this class operate much the same as the 35 mm miniatures, the less expensive being fitted with slow-speed lenses focused by scale. The more expensive have, except for interchangeable lenses and a wide selection of accessories, most of the advantages and facilities of the better 35 mm miniatures. Supplementary lenses (sometimes called "portrait" attachments) are available for most of them. With these the camera can be focused sharply by tape measurement on subjects closer than the usual four- or five-foot minimum focusing distance of the lens mount. In this way larger negative images can

A group of miniature folding roll-film cameras.

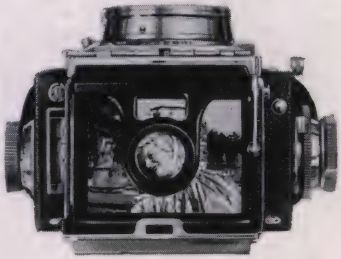
be obtained so that the camera may be used to photograph small objects and to copy pictures, letters, documents, etc.

The Reflex Miniature.

There are two kinds of reflex cameras: the twin-lens and single-lens. Each has its advantages and each type is available in models using 35 mm film in addition to those using larger roll film. One model of the single-lens type is made to take filmpacks, cut film, and plates. Another has a wide selection of interchangeable lenses and accessories, readily adapting it to a varied use including scientific and specialized fields of photography. Interchangeable backs can be fitted to one of the twin-lens type so that it can be used with either filmpacks, cut film, and plates, or 35 mm black-and-white and color film. Among the reflex miniatures there is a wide choice as to the size and type of film to be used.

The twin-lens reflex has two lenses, always of the same focal length, one below the other so they can be focused with the same control. The lower lens, called the **taking lens,** is mounted in a between-the-lens shutter and projects the image onto the film at the back of the camera. The upper lens, called the **viewing lens,** has a mirror directly behind it that projects its image up onto a groundglass, which is viewed from above.

In the single-lens reflex a hinged mirror is interposed between the lens and film so that, when the mirror is in position, the image is projected up onto a groundglass which is viewed from above. The shutter in the single-lens reflex is necessarily of the focal-plane type, behind the mirror and directly in front of the film, since a between-the-lens shutter



The picture image as seen on the groundglass of a twin-lens Contaflex with focusing magnifier in position. The single-lens type shows a like image for focusing.

Typical reflex miniature cameras—both single and twin-lens types.

would not permit the dual job of finding and focusing. This shutter is interlocked with the hinged mirror so that, with pressure on the release button, the mirror springs up just before the shutter opens.

Despite these differences in construction, the twin-lens and single-lens reflexes are operated in much the same manner. Each, however, offers certain advantages and disadvantages. With the twin-lens reflex, the finding image is seen before, during, and after exposure, and its intensity is not reduced by stopping down the taking lens for exposure. Stopping down the lens of the single-lens reflex reduces the intensity of the groundglass image considerably, and the subject is seen on the groundglass only up to the instant before exposure. However, interchangeable lenses and other accessories are available, a feature not generally possible with the twin lens. Since the viewing lens in the twin-lens reflex is placed above the taking lens, the image on the groundglass will be correct only for subjects beyond one fixed distance unless some provision to correct this condition, termed **parallax,** is made. An automatic arrangement that causes the axis of the viewing lens to converge while focusing so as to intersect at the subject with the axis of the taking lens will adjust for parallax. Their fields of view are thus the same. Alternatively, it can be taken care of by means of an automatic

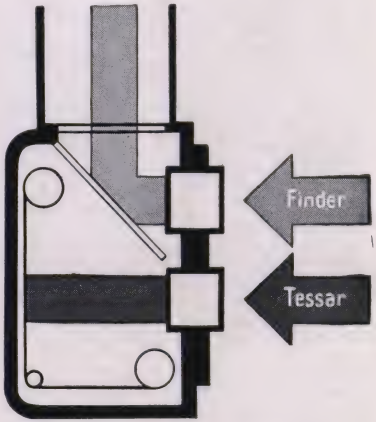


Diagram showing permanent mirror of a twin-lens reflex miniature. Note that viewing lens can be wide open throughout exposure.

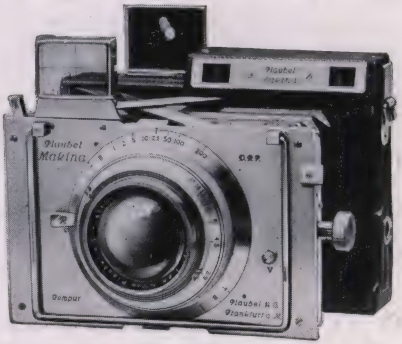
LANDSCAPE, by Fritz Henle, shows excellent judgment in the use of a low horizon to emphasize the beautifully toned sky and clouds.

Taken with a 4x4 cm Rolleiflex on Panatomic film through a yellow filter; 1/100 second at stop *f* 11.

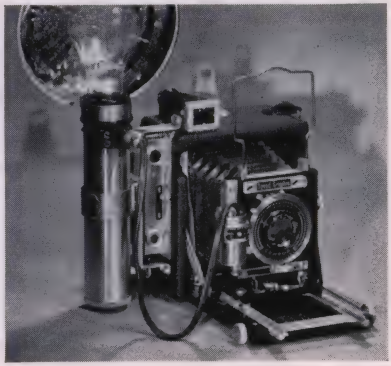
mask under the groundglass that slides back and forth while focusing. Parallax is only serious when the subject is close to the camera, but a good twin-lens reflex will have some adjustment to take care of it.

The Plate-and-Filmpack Miniature.

A greater selection of sensitized materials is available to the owner of a plate-and-filmpack camera with a choice of filmpacks, cut film, or plates. In addition, natural color cut film can be secured for them. By using plate or film holders, different types of sensitized material can be used without the need of unloading and reloading the camera. Also, exposed film or plates can be developed immediately after exposure. With the camera on a tripod, focusing and arranging of the subject can be done on the groundglass back (the image will be upside down and reversed from right to left), or a lens-coupled rangefinder can be attached so that these operations may be done at eye level. The lenses of most plate-and-filmpack cameras are inter-



These are typical members of the plate-and-filmpack miniature group which allows a very complete choice of films and plates.



changeable. Like some of the 35 mm miniatures, they can be fitted with wide-angle lenses. One make of this type comes with a built-in, lens-coupled rangefinder and extra lenses that fit without special adjustment, but generally this equipment has to be separately obtained and fitted.

Your Miniature's Shutter.

Shutters for miniatures are of two types: one that is placed between the lens elements, and another that is placed close in front of the film or focal plane. Either will be found satisfactory. **Focal-plane** shutters have higher maximum speeds and have been proved more efficient, but **between-the-lens** shutters can be more easily synchronized with flashbulbs. With the between-the-lens shutter the entire film is exposed simultaneously, whereas in the focal-plane shutter an adjustable slit travels across the front of the film so that the total time during which the slit travels is greater than the exposure given any section of the film. Therefore, the duration of the flash must be longer than is required for a between-the-lens shutter. However, types of bulbs made to operate with both shutters are now available, and either type of shutter in the miniature size can be synchronized.

Focal-plane shutters made of metal usually cause no difficulty. Those made of a rubberized cloth are likely to stiffen at lower temperatures. As a result, when the temperature is very low, the shutter will slow down or even stop altogether. If much of your work will be done outdoors in cold weather, this defect of the rubberized-cloth focal-plane shutter should be considered.

The speed of some focal-plane shutters is controlled by two knobs, one for adjusting the width of the slit and the other for setting the spring tension—or one for the high speeds and the other for the low speeds. Others are controlled by one knob. The latter, of course, will be more convenient and faster. Self-capping focal-plane shutters, wherein the slit opens to the correct width during exposure and then closes, will be more convenient than

those consisting of a long strip of rubberized cloth with a number of fixed slits of different widths. The latter cannot be rewound until a dark slide is placed in front of the film.

What should be expected of a good camera shutter? The speeds should be adjustable both before and after the spring has been set. In some this can only be done beforehand, while in others it can only be done after the spring has been set or the shutter wound. The shutter should work without lag after it is released, especially if it is to be synchronized with flash. The shutter should not cause vibration and it should work as noiselessly as possible. It should be adjustable for a wide selection of fast and slow speeds as well as time and bulb exposures. The marked speeds should be reasonably accurate. However, even with the finest cameras, absolute accuracy should not be expected. All photographic materials vary to some extent, and a plus or minus variation of ten per cent between the marked and actual shutter speed will cause no particular harm. Dependability—a consistency in shutter speed under varying conditions of temperature and climate—is more important than absolute accuracy between the marked and actual shutter speeds. As a matter of fact, the better shutters today are remarkably precise instruments that will cause no trouble if they are handled carefully and returned to the camera manufacturer occasionally for cleaning. Never take a shutter apart yourself and never attempt to oil one.

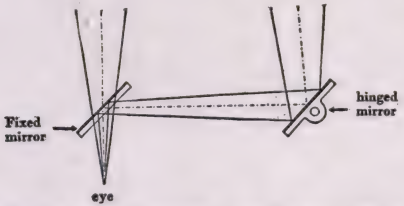
The Rangefinder.

Rangefinders, built-in or attached, are of the superimposed-image or split-field types. In the better miniatures they are coupled mechanically to the lens mount so that the lens is automatically focused. When not so coupled, the distance of the subject is shown on a scale after adjustment of the images; then the indicator of the lens-focusing mount is brought opposite the same place on the distance scale. The coupled rangefinder can be used also

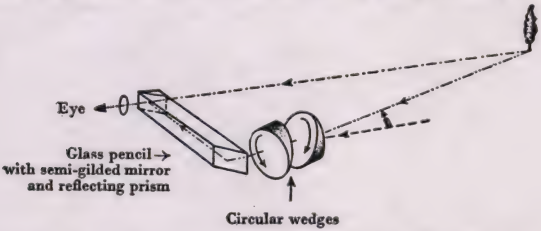
BALANCE, by Werner Stoy, is an example of the pictorial quality that can be obtained with the easily handled and focused miniature.

Taken with a Contax with *f* 1.5 lens through a medium yellow filter; 1/1250 second at *f* 5.6.

as a distance meter by reference to the lens-focusing scale after adjustment of the rangefinder images. The highest development of the lens-coupled, built-in rangefinder is



A diagram of the type of rangefinder using mirrors, or sometimes prisms. The scale on the movable unit is read directly in feet.



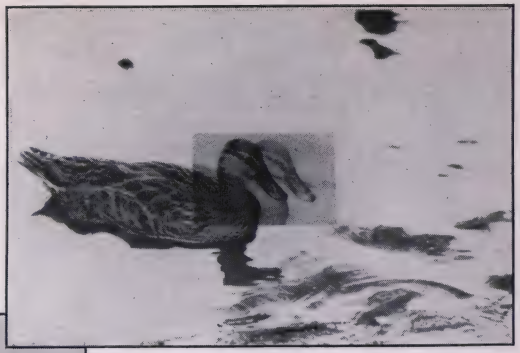
In the rotating-wedge type, the two wedges are sometimes located at the lens and geared to the focusing mount of the folding camera.

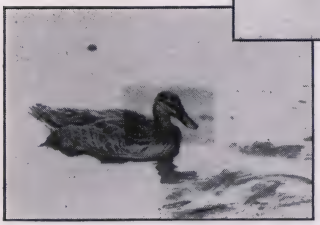
The sliding-wedge rangefinder also lends itself to coupling with the lens to accomplish focusing simultaneously with rangefinding.

found in the dual type of finder. Here ease in operation of the camera and quickness of exposure after focusing is assured by combining the range- and viewfinders in the same eyepiece.

Rangefinders of both types vary widely in their mechanical construction; sliding wedges, rotating wedges, or moving mirrors, lenses, or prisms being used. How-

In the dual finder, or combined rangefinder and viewfinder, the field is identical with that of the lens.





Above: The darker area is that of the moving element as it appears with lens out of focus. Left: When the two images are made to coincide, the linkage of the finder focuses the lens.

ever, since the rangefinders of reputable manufacturers are all accurate and dependable, there is no need to take up their construction here.

Learn Your Camera.

Above all (and I wish this admonition could be engraved on every camera sold) **learn your camera.** A statement that is ungrammatical but true! Regardless of its cost, your miniature is a wonderfully precise instrument that will give you remarkable results if, in addition to learning how to handle and operate it, you will learn to **see** with it. A camera is a tool used for making pictures, not a machine that functions without direction! And the quality of your pictures, beyond their sheer technical excellence, will be determined by how well you can learn how to see with your miniature. There is no miracle type of camera which, because you use it, will lift you out of the ranks of the mediocre. A good worker, even though he has specific preference of his own as to type and make, will turn out good pictures with any good camera.

CHAPTER III

YOUR MINIATURE'S LENS

Its Advantages and Selection.

The eye with which your miniature sees—the lens—is of the utmost importance. While all the materials and operations in photography are important for good results, more depends on the lens than on any other single factor. Its definition—the keenness of its vision at all distances and apertures—is what determines the sharpness of the negative image. And without that definition, which is more of a requisite with the miniature than with the larger cameras, the best results will not be secured.

Fortunately, however, there are certain definite advantages in the design and construction of the short-focus lenses for the miniature. Both a higher degree of correction and a greater maximum speed are attained more easily and at less expense. Even miniature telephoto lenses of the same relative focal length as large-camera lenses have this same advantage on account of the much smaller angle, or field of view, they are required to cover. It makes possible the construction of low-cost miniature lenses with fairly good definition and a relatively high maximum speed. In the more expensive field miniature lenses can be made of a maximum speed with definition that would be impossible with the long-focus lenses of the larger cameras.

Even though remarkable results have been obtained with very inexpensive miniature lenses, get the very best lens equipment you can afford. Three factors influence the cost of a lens: the quality, the maximum aperture or speed, and the focal length. Since the normal focal length for a given negative size is fairly standard, the variables in your choice are quality and maximum speed.

QUEEN MARY, by LeRoy Roselieve, illustrates excellent use of an extreme perspective to accentuate the characteristic lines.

Taken with a Contax with *f* 1.5 lens on Superior film; the exposure was 1/50 second and lens opening was *f* 11.

If economy is necessary, sacrifice speed before quality. The former is an asset, the latter a requisite.

The Circle of Confusion.

Theoretically, a lens can be focused sharply on only one plane perpendicular to a line passing through the centers of surface curvature of all its elements, called the **optical axis** of the lens. This plane will be parallel to the plane of the film. A point in any other plane than that on which the lens is focused will appear in the negative as a disc instead of a point. This disc, called the **circle of confusion,** will be larger the greater the distance of its plane from the plane on which the lens is sharply focused. Because, however, discs up to 1/100 inch in diameter cannot be distinguished by the eye from points at normal viewing distance, circles of confusion of this size are permissible in the finished print or enlargement. Therefore, knowing the linear times enlargement of the negative in making the average print, we can easily calculate the permissible circle of confusion for our miniature negatives. Since practically all films have a maximum **resolving power** of about 1/1000 inch, this is the maximum circle of confusion to allow for negatives under any circumstance. The minimum circle of confusion to allow, if enlarging to 8x10 or greater, is 1/750 inch for 35 mm negatives and from 1/400 to 1/500 inch, depending on size, for the larger miniature negatives. Enlargements to 5x7, of course, will permit circles of confusion of 1/500 inch for the 35 mm size and from 1/300 to 1/400 inch for the larger sizes.

The Hyperfocal Distance.

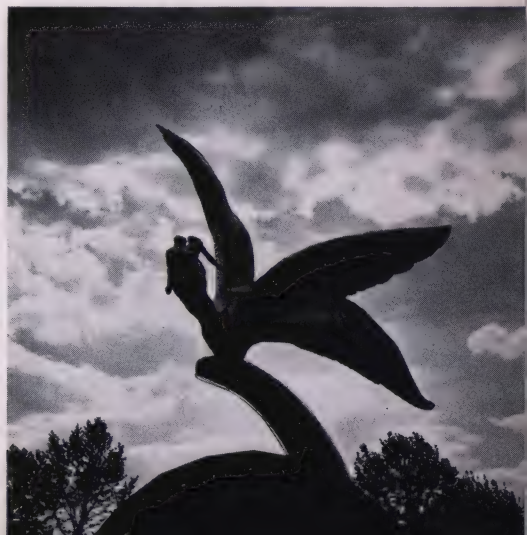
Knowing about the circle of confusion we can understand why objects in nearer planes will appear sharp in the print when the camera lens is focused on infinity. The distance of the nearest sharp plane, called the **hyperfocal distance,** is determined by the diaphragm setting, the focal length of the lens, and the permissible circle of confusion in the negative. Now, if the lens is

focused on the hyperfocal distance, everything from half that distance to infinity will appear sharp in the picture provided the selected circle of confusion is not too great. The hyperfocal distances for the lens of your miniature at various diaphragm settings (calculated for a circle of confusion that will allow for at least 8x10 enlargements) is usually given in the instruction book that accompanies the camera. If not, one can be computed easily with the following formula:

$$\mathbf{H} = \frac{\mathbf{F}^2 \times \mathbf{C}}{f}$$

where **H** is the hyperfocal distance, **F** is the focal length of the lens, **C** is the denominator of the diameter of the permissible circle of confusion, and ***f*** is the *f*-number or aperture of the lens.

If there is a depth-of-field scale opposite the focusing distance scale of your miniature, you will not need a table of hyperfocal distances. To focus the lens on the hyperfocal distance, bring the infinity mark on the distance scale opposite the same *f*-number on the depth-



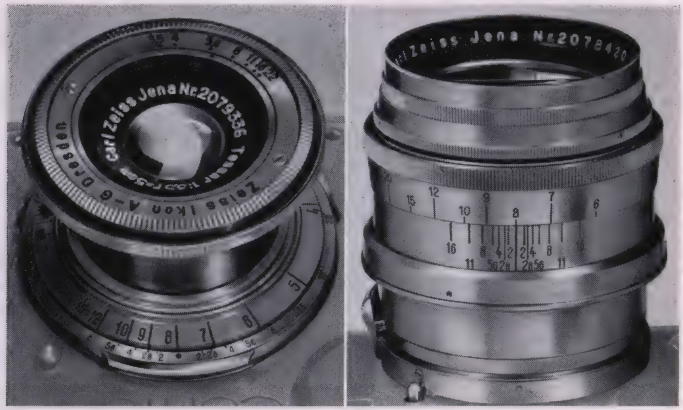
WINGS . . . . . .
An outstanding picture of the well-known statue at the New York World's Fair, by Jerry Arends.

Taken with an Ikoflex with an *f* 2.8 lens, through a yellow-green filter; 1/50 second with aperture at *f* 8.

of-field scale as that to which the lens diaphragm is set for the exposure. Then on the distance scale the point opposite the focusing index mark will be the hyperfocal distance, and the nearest distance that will be sharp in the picture is indicated on the distance scale opposite the same aperture at the other end of the depth-of-field scale. If this sounds difficult, get your camera right now and see how easy the operation really is. But, whether you do it with a scale on your camera or from a table carried in your pocket, focusing to the hyperfocal distance is often more desirable and convenient. It can be done with many kinds of miniature work, and without need for constant manipulation of the camera controls your attention can be given entirely to the subject, frequently a necessity in fast action and sports work.

Depth of Field.

When a lens is focused on points in a plane closer than the hyperfocal distance, the farthest plane in sharp focus will be nearer than infinity. The distance from



With both the above lenses set at 8 feet and *f* 8, the short focal length lens (left) shows on the depth of field scale a sharp focus from 6 to 12 feet, and the long lens a sharp focus from 7 to 9 feet.

the nearest plane to the farthest plane that will be sharp in the picture is called the **depth of field**. As with the hyperfocal distance, its extent is dependent on the diaphragm setting, the focal length of the lens, the permissible circle of confusion in the negative, and—in addition—the distance of the plane on which the lens is focused. Tables giving the depth of field of the lens at various distances and for various diaphragm settings are practically always given in the instruction book that accompanies your miniature camera. In addition, as has been mentioned, many miniatures have depth-of-field scales opposite the distance scale of the lens so as to provide immediate information concerning the depth of field as the lens is focused. If the depth-of-field tables for your lens are not given, or you wish to calculate such tables for different circles of confusion, the following formulas may be used:

Another form of depth of field scale on the Ikoflex III.

$$L = \frac{H \times D}{H + D} \qquad M = \frac{H \times D}{H - D}$$

where **L** is the nearest plane and **M** is the farthest plane that will be sharp in the picture, **H** is the hyperfocal distance of the lens for the particular diaphragm setting, and **D** is the distance on which the lens is focused. In using the formulas given in this and the preceding section, make sure that all distances are in the same units, either inches or centimeters generally being the most convenient.

It is useful to know that the depth of field of a lens varies as follows:

1. Becomes **less** as the diameter of lens diaphragm becomes greater;
2. Becomes **less** with a lens of longer focal length;

3. Becomes **greater** as the distance of the subject from the camera is increased;
4. Becomes **less** as the size of the permissible circle of confusion is decreased.

This is true provided, of course, that in each instance the three other variables remain the same.

Focusing the lens on the hyperfocal distance for the required aperture will be most useful outdoors when the light is good and the diaphragm can be set at *f* 8 or smaller with the nearest plane of the subject that must be sharp in the picture not closer than nine or ten feet. In fact, red dots are marked on the diaphragm and distance scales of the lenses of some miniatures to indicate the setting of both for this "universal focus." The depth-of-field tables (or scales if they are marked on the lens of your miniature) are used to their best advantage when conditions require larger diaphragm openings or the subject is closer to the camera than nine or ten feet. You will find, though, that both tables and a working knowledge of their use will be advantageous in many applications of miniature photography. With a little practice their application becomes almost automatic, especially if they are marked as a scale opposite the distance scale on your lens mount.

While knowledge concerning lens aberrations is interesting to some, it will be of little advantage to the average miniature worker. Since most camera users do not have facilities to determine the degree of corrections in their lenses any detailed discussion here on lens aberrations and their corrections would seem pointless. If you are interested in knowing more about this subject, also about image formation and the construction of lenses, good books are available for reference.*

Extra Lenses for Your Miniature.

Additional lenses are not available for all miniatures, although those which have removable lenses can be fitted with other lenses of various speeds and focal lengths. While not a necessity, they are certainly an advantage,

*This subject is discussed fully in *Photographic Lenses and Shutters*, (Little Technical Library, No. 17). See page 119 in this book. Ed.

and the miniature with interchangeable lenses is more versatile. In the same focal length as the normal-focus lens of your miniature, interchangeable lenses give a choice of different maximum lens speeds for varying conditions. The normal-focus lens, if removable from the camera, can be used in the enlarger, saving the cost of another lens for that purpose. In other focal lengths than the normal one for your miniature, interchangeable lenses are employed for a wide variety of useful purposes:

1. To secure different-size images of the principal subject of the picture from the same camera position, thus allowing control in the extent to which the principal subject dominates the picture.
2. To secure a larger-size image when the camera cannot be brought closer to the subject, thus reducing the need for extreme enlargement.
3. To include the entire subject in the negative when the camera cannot be moved away from the sub-

JUMP TURN . . . . . In such shots as this, the action is usually prearranged to take place within the depth of field. By Oddie Monahan.

Taken with a Super Ikonta C with *f* 4.5 lens, through a yellow filter; 1/400 second at *f* 5.6.

ject and the angle of view of the normal-focus lens is not great enough to do so.

4. To control perspective in the picture without loss of image size or part of the subject in the negative.
5. To permit arranging and composing within the exact picture area at the time the picture is taken without any need for later cropping or trimming, or to reduce cropping or trimming to a minimum.

Perspective.

Mention has been made that interchangeable lenses can be used to control picture perspective without loss of image size or part of the subject in the negative. Perspective itself is not a matter of lens focal length as many think. It is a matter of **camera position and viewpoint.** If the camera is used too close to the subject, distortion will result. Objects nearer the camera will be too large for surrounding objects a little farther away, and the increased perspective caused by the close camera position will appear unpleasant in the picture. Conversely, the camera can be moved such a distance away from a subject that the perspective will be reduced. The different planes in the subject will then appear too close together, and again the picture will not appear natural.

With your miniature at the same distance from the subject the perspective will be the same regardless of whether you use a 3.5 cm lens or an 18 cm lens. Only the angle of view covered and the size of the image will vary. If you don't believe this, take a picture of the same subject from the same camera position with two cameras having lenses of different focal length or the same camera with two lenses of different focal length. Enlarge each negative so that the same subject area appears in each enlargement. Then study the two prints and see if the perspective is not identical.

Then, you rightly ask, how will lenses of different focal lengths aid in controlling perspective? Let's take

a few actual examples by well-known photographers as illustrations. Here is a landscape with a magnificent tree in the foreground and a majestic range of mountains in the far distance. The tree is shown in large size with all the exquisite detail of its leaves and branches, yet the mountains stand out strong and high in the background. If this picture were made from close range with a 35 mm miniature fitted with its normal-focus 5 cm lens, the tree would be shown in the picture as desired. But the mountains would appear too small and insignificant; they would seem too far away.

Now move the camera twice the distance from the tree. The tree will now be half the size while the height of the mountains in the distance will remain unchanged. The difference between the two will be lessened and each will be shown more in its correct relative size. But only half the area of the negative will be used, twice as great a degree of enlargement will be required, and undoubtedly much of the delicate detail in that beautiful tree will be lost. With a telephoto lens the image at the greater distance will be the same size as the image with a 5 cm lens at the closer distance, yet the perspective and appearance of the picture is greatly improved without any loss of detail and gradation.

Let's take another example, this time with a wide-angle lens. Here's a traffic policeman, just as we see him when we are caught trying to beat a traffic light, his outstretched hand sticking out as though it would push our car right back into line where it belongs. In making this picture the hand must dominate everything. The policeman's face and arm should appear, but they must be small and off in the distance. So we bring our miniature close to the outstretched hand in order to increase the perspective between the hand and face. But the angle of view of our 35 mm miniature with its normal-focus 5 cm lens will cover only the hand. If we back far enough away to include some of the face, the perspective is not violent enough to give the desired effect of extreme distortion.

The idea will make a prize-winning picture. What can we do to save it? Simply substitute a wide-angle lens in our miniature, preferably the 2.8 cm although a 3.5 cm will do. Now the angle will be wide enough so that the entire hand will be included, and by moving the camera slightly to the side the arm and head will also appear. The resulting picture will show that hand, big as life, with the arm stretching back to a distant face crowned with a hat that belongs unmistakably to a policeman. The picture needs no title; one look at it and we say, "Stop." See how well Bob Leavitt executed this striking picture idea of his own.

The Selection of Extra Lenses.

The miniature worker who is able to afford a whole battery of extra lenses need give little thought to their selection. All of them will be useful sometime or other, and one or two will be found indispensable. Most, however, are not so fortunate, and one or two additional

STOP . . . . . An excellent example of the extreme depth obtainable with a wide-angle lens; photograph by Bob Leavitt, A.R.P.S.

Taken with a Contax with wide-angle *f* 8 lens; 1/50 second exposure, aperture *f* 16.

lenses must serve for all purposes. Their selection should be given careful study and consideration.

There is one easily-understood optical rule that will be helpful in the selection of extra lenses. The size of the images obtained with two different lenses the same distance from the subject will vary directly as their focal lengths. Therefore, the 13.5 cm lens of a 35 mm miniature will produce an image on the negative 13.5/5 or 2.7 times as large as that produced by the standard 5 cm lens with the subject the same distance from both lenses. Under the same conditions a 3.5 cm lens will produce an image 3.5/5 or 0.7 as large. Therefore, to find the comparative sizes of images produced by lenses of different focal length at the same distance from the subject, divide the focal length of one lens by that of the other. This rule holds true regardless of the angle or field of view that the different lenses cover. Negative size makes no difference either.

Do not get an extreme telephoto or extreme wide-angle lens unless you definitely need one or the other. Many miniature workers have additional lenses of too wide or too narrow an angle to suit their needs. With a battery of five lenses ranging in focal length from 2.8 cm to 13.5 cm from which to choose for my 35 mm miniature, an exposure data check-up shows that the 8.5 cm and 3.5 cm are used most, the 5 cm next, and the 2.8 cm and 13.5 cm least. Many other advanced workers report the same experience. So go slow and give plenty of thought to the selection of additional lenses for your miniature. If possible, pick them on the basis of an actual working test that will really show your average needs. Don't buy an expensive lens for that extreme shot you may make only once or twice a year.

CHAPTER IV

LENS ACCESSORIES FOR YOUR MINIATURE

Filters.

While modern panchromatic films are remarkably sensitive, they are not equally sensitive to the different colors of the spectrum, and no film has a sensitivity to all colors like that of the normal eye. If colors are to be reproduced in shades of black and white that approximate their average visual intensity, the color or colors to which the film has a greater comparative sensitivity must be reduced in intensity. This is done with filters. From the picture-maker's viewpoint, though, this is one of the least of their many applications. Overcorrection or undercorrection is frequently employed in securing a particular effect or mood. Filters have many other uses as well. Indeed, their application in black-and-white miniature photography is so valuable and extensive that they are among the most important accessories in the picture-maker's kit bag.

The four filters that will suffice for most miniature workers are the medium yellow, the orange, the light red, and the yellow-green or light green. The first three will be used most frequently to darken the sky tones so as to make the clouds stand out more prominently. They also increase contrast and can be used to reduce the effect of haze in long-distance shots. In addition, the yellow-green or light green filters are used to record detail in the shadow side of the subject when making pictures against the light. They also obtain differentiation between varying shades of green in landscapes. Of the four, get the medium yellow filter first since it will be the most useful. When you have learned what can be done with it, get the orange filter for more control over contrast and sky tones. The yellow-green or light green, the lat-

SNOW TRAIL, by Dr. Stephen White, A.R.P.S., is a good example of filtering to increase shadow contrast.
Taken with a Super Ikonta B with *f* 2.8 lens through a medium yellow filter; 1/50 second at *f* 16.

ter having slightly more effect than the former, should be next. Then, if you want a greater degree of over-correction, get the light red filter. While the under-correction secured with a blue filter is seldom desired, some light blue filters will give the same effect with panchromatic film and electric light as would be secured with the same film outdoors without a filter. Such a filter might occasionally prove useful.

These are only a few of the uses you will find for the filters recommended. When you try them out you discover many others and will acquire a mastery that will make them among your most valuable accessories. Always remember that filters are used to secure definite effects. It is only from a study of pictures deliberately made with and without filters or with two different filters for comparison, plus the actual experience, that you will gain the proficiency needed to get any desired effect. Then you may find it interesting and useful to learn more about their theory and specialized applications.

Polarizing Filters.

Also called polarizing screens, they are not color filters, although they are used in much the same manner and require an increase in exposure. Their object is

The left of these two photos was taken with a bare lens, while the right was taken through a polarizing filter. Note that the disturbing reflections in the window have been almost entirely eliminated.

to eliminate undesired reflections and otherwise vary the intensity of light from different objects. They consist of a crystalline material, in which all the crystals are oriented in the same direction, placed between glass. The direction in which the crystals are oriented, generally marked on the mount, is called the plane of polarization. While the application of polarizing filters or screens is limited, very interesting effects can be obtained with them.*

Supplementary Lenses.

The minimum distance to which most miniature cameras can be focused varies from three to six feet depending on the focal length of the lens and the type of camera. For copying or photographing small objects, a nearer minimum distance is necessary to obtain a larger image. This can be done with miniatures having interchangeable lenses by the use of a lens-extension tube of correct length. Plate-and-filmpack miniatures having double-extension bellows can be brought nearer by extending the bellows to a greater length and focusing the subject on the groundglass. Other miniatures can also be used for such closeup work with the aid of positive supplementary lenses. These are sometimes termed "portrait attachments" or "portrait lenses," although the greatly increased perspective at such close distances will make the picture more a caricature than a representation of the subject. Supplementary lenses are also used with 35 mm miniatures having interchangeable lenses to avoid the use of lens-extension tubes which can only be used at fixed distances unless fitted with helical focusing mounts. They are sometimes used with double-extension plate-and-filmpack miniatures to obtain larger images than are possible with the full extension of the camera.

Except with miniatures having groundglass focusing, the distance of the subject must be measured when supplementary lenses are used. Guess-focus is not accurate enough since the depth of field is very small. With single-

*This subject is discussed fully in *Filters and Their Uses*, (Little Technical Library, No. 3). See page 119 in this book. Ed.

lens reflex cameras, focusing is done on the groundglass, and no measurements are necessary. Placement of the subject so that it will be centered on the negative will be a problem except with single-lens reflexes and miniatures having groundglass backs. When letters or documents are being copied, it can be solved by placing the camera directly over the subject and suspending a plumb bob from the lens. Some guesswork will be required with other subjects and the image should not be made so large that there will not be some free space around the edge of the negative to provide a margin for error. One 35 mm miniature solves this problem with a near-focusing attachment that consists of three supplementary lenses and a supplementary range- and viewfinder combined. This permits the miniature to be held in the hand within eight inches of the subject with rangefinder focusing and automatic allowance for parallax.

Exposure meter readings should be taken at such a distance from the subject that the meter covers the same field that will be included in the negative. Be sure that the illumination for the exposure is the same as when the reading was taken. If filters or other lens attachments are used with a supplementary lens, place the supplementary lens next to the camera lens. A supplementary lens should always be centered correctly with the lens to which it is attached. Screw-in mounts are best, for then the optical axis of the supplementary lens will always coincide with that of the miniature's lens. Slip-on mounts will be satisfactory if they are pushed on the lens mount as far as they will go.

Supplementary lenses alter the focal length of the lens on which they are placed, the positive supplementary lens used for closeup work shortening the focal length. Another type, the negative supplementary lens, lengthens the focal length of the lens to which it is attached; it can only be used for this purpose with cameras having a means for placing the lens at quite a varied distance from the film. In shortening the focal length, the positive supplementary lens gives the same effect as would

HOPI INDIANS, by Anton F. Baumann, is an example of travel pictures in which foreground figures are used to add human interest and scale.

Taken with a Leica with *f* 4 lens through a yellow filter on Panatomic film; 1/200 second exposure at *f* 6.3.

be secured with a wide-angle lens while the negative supplementary lens gives the effect of a telephoto lens. When using them, due to certain aberrations they introduce, the lens diaphragm should be set at *f*11 or smaller.

Soft-focus Attachments.

Some subjects require a warmth and softness in tone and outline rather than the brilliance and sharp definition obtained with modern miniature lenses. This softness can be obtained with a soft-focus supplementary lens when the picture is taken, or by diffusion obtained when the picture is enlarged. The first method is best, for when diffusion is obtained in enlarging, the shadows merge into the highlights which is the reverse of what actually occurs in nature. When the soft-focus supplementary lens is used, however, the highlights merge into the shadows and appear correct in the picture. Soft-focus supplementary lenses do not alter the focal length or the marked diaphragm settings, and no increase in exposure is necessary. Since closing the diaphragm reduces the effect, a fairly wide aperture should be used in making the exposure, between *f*4 and *f*5.6 generally being best. Since the soft-focus attachment weakens contrast, a light or medium-yellow filter should be used with strong diffusion or weak-contrast subjects. When used with other lens accessories the soft-focus element should be placed next to the lens unless used with a positive or negative supplementary lens, when the latter should be next to the lens. Soft-focus supplementary lenses serve very well for portraits, subjects photographed against the light, and flowers, although there are many other instances where they will be useful.

Special Viewfinders.

Every miniature is fitted with some sort of a finder, but the built-in finder will not always be the best for every occasion. A special finder will be needed for extra lenses unless they are of the same focal length as the standard lens. Special finders are available for sports

and fast action photography, for shooting "round the corner" in candid work, for accurate viewing at distances closer than ten feet to the camera, and a host of other purposes. Brilliant waist-level viewfinders can be had for several eye-level miniatures so that they can be used at waist level.

Lens Shades.

Last but not least of the lens accessories is the lens shade. It is sometimes called "sunshade," but that is not the correct term, for it should always be used whether the sun is shining or not. Make sure that your filters and supplementary lenses are so constructed that the lens shade will fit when they are in place. This problem is easily solved with the combined lens shade and filter holder, in which space is provided for the filters.

Check the lens shade carefully before using it with a wide-angle lens; frequently one that is all right with standard and telephoto lenses will be inadequate for a wide-angle lens and cut off part of the view. One shade provided for a 35 mm miniature can be adjusted for different focal length lenses.

CHAPTER V

OTHER ACCESSORIES FOR YOUR MINIATURE

A MULTITUDE of camera accessories are provided for your miniature, and most are good. To the individual worker, however, not all accessories will be useful. No standards can be set in this respect, and one worker's accessory will be another's gadget. Beware of the gadgets; they clutter the kit bag and complicate miniature photography no end.

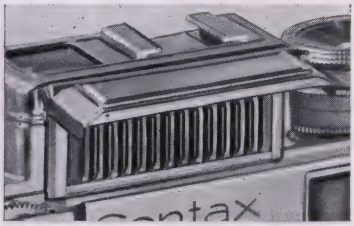
What accessories are really needed by every miniature worker? First and most important (if not built into the camera) is a good, reliable exposure meter. Because it relies least on judgment and visual observation, the photoelectric-cell type is preferred. If this represents too much of an investment, the extinction type is next best. It contains a series of figures or letters of varying density. The dimmest figure or letter seen through the eyepiece when the meter is pointed at the subject represents the light value. This light value can be translated into the correct diaphragm setting and shutter speed for the film being used by adjustment of a scale around the meter. Other types of meters are available, but these two are the most generally used. Any meter is better than none, and it is poor economy to try to get along without one. This matter will be discussed again when we come to the subject of exposure.

A strong, rigid tripod, fitted with a ball-and-socket or a pan-and-tilt head, is the next requisite. The legs should be easily extended, and the type that can be fastened at any height up to the full extension is preferable. The tripod should stand at least five feet high with the legs fully extended and spread apart. The head should move smoothly and tighten easily. If the legs are not of the reversible type with spikes at one end and rubber

The inconspicuous miniature camera can often make splendid pictures out of normal activities, catching a very welcome spontaneity of pose.

Taken with a Kodak 35 on panchromatic film.

tips at the other—get a set of rubber tips that can be fastened over the spikes when the tripod is used on a hardwood floor or other smooth surface. In addition to being strong and rigid, the tripod should not be so bulky and heavy as to be inconvenient to carry. Most of the so-called pocket tripods are too rickety and too short. The best way to carry a tripod is in a case with a shoulder strap or by fastening it to the outside of the kit bag by means of leather straps.



The opened window of the built-in photoelectric exposure meter.

Substitutes will sometimes serve in place of a tripod, and one or another generally can be used where a tripod cannot. One consists of a short, extensible rod fastened by a swivel joint to a canvas or leather strap. Slung around the neck, the strap is adjusted so that the swivel-joint end of the rod hangs at the waist; the rod is then extended so that a camera fastened to the tripod screw at the other end is held at eye level. Another is a single, telescoping rod that extends to about five feet. A tripod screw at one end holds the camera, and the other end of the rod is rested on the ground or other firm support. Either will be more useful if fitted with a ball-and-socket head. As with a tripod, rigidity and adjustability at any point up to the full extension are to be sought. While neither will completely replace the tripod, with practice either can be used with shutter speeds up to one-half or one full second. Steadiness can often be attained by utilizing the strap of the carrying case, using the elbow or foot to keep tension on the camera to avoid motion.

Last, and important for protection, is a carrying case or kit bag for the miniature and its accessories. The better type will have a zippered pocket on the inside near the top for filters and other pockets for the camera and

extra lenses. The shoulder strap and bag should be well reinforced where joined, and the strap should have a buckle so its length can be adjusted.

These are all the accessories really needed at the start. It is assumed that the lens shade will be included, for its use assures greater brilliance in your pictures. Many miniature workers are producing exhibition prints or readily-saleable pictures without any other additional equipment. Always remember that a minimum of equipment, a maximum of ideas, and a little ingenuity will accomplish much more than all the accessories ever manufactured. The miniature is a fine tool rather than a machine, and its accessories should be useful to the extent that they aid subordinately in using it to perform a photographic task.

Photography with Floodlamps.

Long before the urge to explore the fascinating opportunities of controlled light begins, you will have tried electric-light photography with the usual lights at home and elsewhere. With the modern, high-speed films, an *f* 3.5 lens, and normal lighting, remarkable results are possible. But better pictures can be taken with the powerful, easily-controlled light furnished by a floodlamp and inexpensive reflectors and stands. The bulbs cost from twenty cents up, depending on the strength of their light, and two reflectors can be had from two dollars up. Diffusers to soften the light can be made from tracing paper, or they can be bought ready-made at little cost. Excellent results can be secured from a simple, inexpensive set of lights with a little practice.

Flash Photography with Your Miniature.

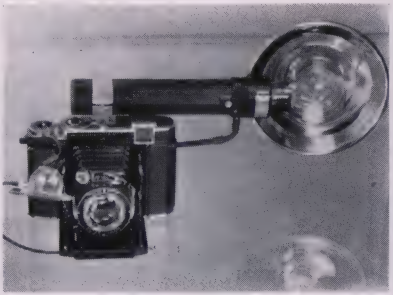
The flashbulb offers a multitude of opportunities to the miniature user. As the floodlamp makes the use of the camera in the evening easily possible, so the flashbulb makes miniature photography possible anywhere by night or day with no dependence on weather conditions or electrical supply lines. If the light outdoors during

the day is not strong enough for high shutter speeds, or if the near side of the subject is too dark when contrasted with the background, the flashbulb can be called on to supplement the deficiency. Indoors, flashbulbs can be used when the light intensity from the floodlamps is not strong enough and additional bulbs cannot be added because of the capacity of the lighting circuit. The use of flash is practically unlimited, for the light emitted is tremendously powerful, modern methods of construction practically eliminate the possibility of explosion, and two or three small flashlight batteries are strong enough to fire the bulb.

All types of bulbs can be used to make flash pictures with the open-flash method. With the camera on a tripod and focused, the subject is arranged. Then, in rapid order,

AIRLINE LUNCH, by Anton F. Baumann, is typical of the type of photo requiring a synchronized flash to obtain sufficient light. Taken with a Leica, *f* 2 lens, on Panatomic film at 1/200 second at *f* 9.

the shutter is opened on bulb, the bulb flashed, and the shutter closed. The full advantages of flash, however, are not gained with this method of exposure. The ideal condition is to have the shutter open for an exposure of 1/100 second or less at the peak of the flash. On account of the split-second precision that timing the flash to fire at the instant the camera's shutter is opened requires, this ideal condition is only attained with a flash synchronizer. With some miniatures the synchronizer is built into the shutter—the ideal condition. There are several different types of synchronizers, and the choice will be somewhat of a problem. A type that will be best and most convenient with one kind of miniature will not always serve so well with another. Some manufacturers therefore have designed special models for specific types of cameras. Others provide special brackets and fittings. Properly arranged and adjusted, all of the synchronizers of the reputable manufacturers (except the special models) will work satisfactorily with almost any miniature. Some may require adaptors, but these are furnished with them.



This folding miniature has been equipped for synchronized flash.

Adjustment of the synchronizer with the shutter of your miniature should be checked before attempting to make pictures. Two synchronized flash exposures—one at 1/50 and the other at 1/200 second—are made in a dimly lighted room. The diaphragm setting should be *f*8 and the subject should be about eight feet distant with a medium-speed panchromatic film. The two exposures should be developed together for the same length of time, and both should be equally satisfactory, the 1/50 second exposure being denser. If both are thin with no

visible difference between them, the peak of the bulb is reached before the shutter opens. With the 1/50 second exposure correct and the 1/200 thin or blank, the shutter is opening before the peak of the bulb is reached. Adjustment for either condition is made in accordance with the instructions accompanying the synchronizer.

Two warnings! First: your synchronizer is intended for use with flashlight batteries and not the house current. The batteries will fire from one to three bulbs. If more are to be fired at one time, synchronization can be secured through a special relay connected with the house current. If the house current is passed through the synchronizer, it will be ruined. Unsynchronized flashbulbs, though, can be ignited by the house current without any difficulty. Second: always use reflectors. With them, all of the light is directed toward the subject and none is wasted. Exposure tables are furnished by the manufacturer.

Closeup Photography.

One of the most interesting—and sometimes one of the most useful—applications of the miniature is picturing objects that are nearer than the minimum focusing distance. The latter is from three to five feet, depending on the focal length of the lens and the size of the negative. Such an application of the camera is called **closeup** photography or **photomacrography.** The purpose, of course, is to obtain larger images than would be secured with the camera at or beyond the normal minimum focusing distance. In this way, pictures of very small objects can be made the same size or greatly enlarged. Closeup photography finds a wide application in the photography of book pages, written or printed matter, sketches, drawings, and other such material. It is also extensively used in medical, dental, and other scientific and specialized photography for record, instruction, and lecture purposes. These are only a few examples of the wide use of the closeup in all fields and phases of photography. Wherever a large image of a small object is required, closeup photography is indicated.

CHICK, by Alan Fisher, exemplifies the closeup work that can be done with a miniature capable of focusing near objects, or when an optical focusing device is used with a supplementary lens.

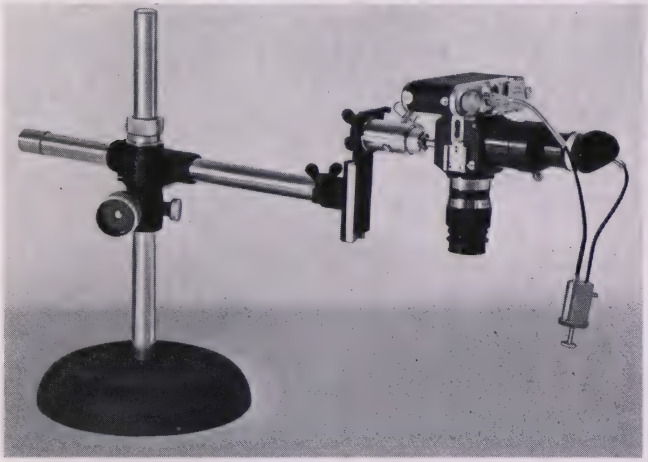
Taken with a Super Ikonta B and *f* 2.8 lens, with a supplementary lens and Contameter, on Superpan Supreme; exposure 1/100 second at *f* 22, with a synchronized flash.

Plate-and-filmpack miniatures having double-extension beds can be focused so close to the subject that images as large as the subject can be obtained. The groundglass back is used to secure sharp focus and to frame the subject on the film. With other miniatures, closeup photographs can be secured with the aid of supplementary lenses. In this way, images ranging in size from 1/10 to 1/5 that of the subject are easily obtained. Since the distance must be measured by rule and is critical because of the shallow depth of field even with small diaphragm openings, the camera should be placed on a tripod or other firm support. Of course, if the lens of the camera is removable, an extension tube between the

LIVE KATYDID, by Fenwick G. Small, is an example of the use of a near-focusing attachment for making pictures of the insect world. Taken with a Contax and *f* 3.5 lens, with a supplementary lens and Contameter, on Superpan film at 1/50 second and lens stop of *f* 8.

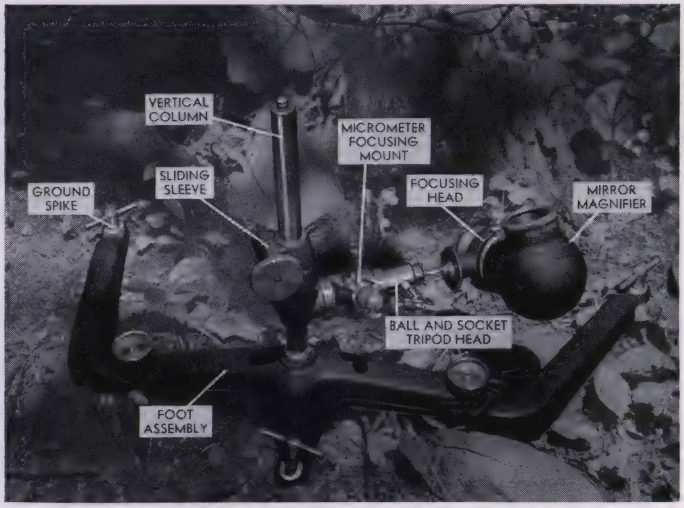
lens and the camera can be used in place of the supplementary lens. This procedure is not recommended, however, unless the camera has a groundglass back or is of the single-lens reflex type. The use of supplementary lenses is more practical and easier.

Closeup photography attains its greatest usefulness and application with the 35 mm miniatures having removable lenses and special accessories for this type of work. The greatest flexibility and largest images are attained with the use of lens extension tubes. The lens is focused by sliding it back and forth if it is of the type that can be recessed in its mount, or by means of a special helical-focusing mount that fits the tubes. Placement of subject in negative area and sharpness of focus are secured by a multitude of devices ranging from mirror-reflex attachments placed between the lens and camera to special groundglass attachments that fit over the top of the extension tubes in place of the camera. All sorts of devices are provided to hold the camera, lens, and subject in posi-



This miniature camera has been mounted on a stand capable of exact movements, and is equipped with a reflex attachment for focusing.

tion during focusing and exposure. A full description of all the available accessories for specialized purposes cannot be given in this space, but the dealer or manufacturer will be able to give you complete information concerning the varied closeup equipment for your miniature.



This sturdy and adaptable stand holds the miniature camera with perfect steadiness during exposures of closeup subjects in the field.

Illumination is of primary importance in closeup photography, especially if the subject is a letter, book page or other flat material with a high reflective capacity. In work of this nature, two or four lights are preferable, and they should be so placed that reflections from the surface of the copied material will pass outside the field of the lens. The lights should not be brought too close to the subject, in order to insure that the illumination will be even over the entire surface. Since the lens is much farther from the film than normal, the marked apertures

will not be correct. The actual *f*-number can be figured by means of the following formula:

$$\frac{\mathbf{F}}{\mathbf{D}} = \frac{\mathbf{A}_1}{\mathbf{A}_2}$$

where **F** is the focal length of the lens, **D** is the distance of the lens from the film, $\mathbf{A}_1$ is the *f*-number marked on the lens, and $\mathbf{A}_2$ is the actual *f*-number. A very slow-speed, finegrain panchromatic film should be used; the color-blind type will be satisfactory with black-and-white subjects, but the panchromatic film should be used with subjects having two or more colors. Exposure can be calculated by meter. However, it is well to make a series of at least three exposures—one as indicated by the meter, another half that amount, and the third twice that amount.

The following formula will be helpful in determining the tube length required to secure a given image size from a specified object:

$$\mathbf{E}_1 = \mathbf{F} \times \mathbf{R}$$

where $\mathbf{E}_1$ is the tube extension minus the focal length of the lens, **F** is the focal length of the lens, and **R** is the ratio of the image to the object. Remember, however, that to secure the tube length the focal length of the lens must be added to the result from this formula. Similarly, the distance of the lens from the subject can be determined from the following:

$$\mathbf{E}_0 = \frac{\mathbf{F}}{\mathbf{R}}$$

where $\mathbf{E}_0$ is the distance between the lens and subject minus the focal length of the lens, **F** is the focal length of the lens, and **R** is the ratio of the image to the object. Again, the focal length of the lens must be added to the result from this formula in order to secure the exact distance from the lens to the subject.

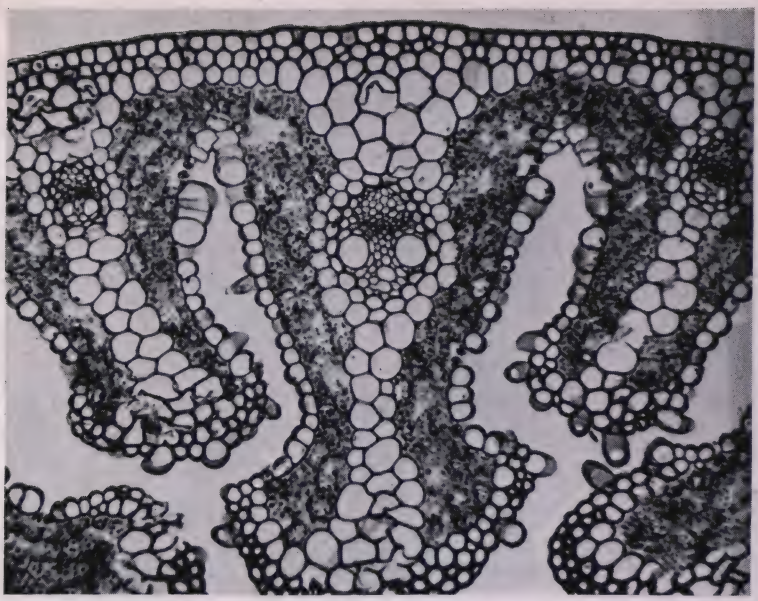
Photomicrography.

Any camera can be used for photomicrography in conjunction with a microscope. If the camera lens is not removable, it is focused at infinity and the camera is placed so that the lens is directly above the eyepiece of the micro-

scope. If the lens can be removed, which is preferable since it serves no useful purpose, the camera is placed so that the microscope eyepiece is directly over the opening for the lens and the space between is covered so the film will not be light-struck. Special attachments are provided for many of the 35 mm miniatures having removable lenses, and these make photography with the microscope fairly easy. With some, the microscope image can be seen on a groundglass that interchanges with the camera by a sliding device or by a bayonet mount on each that fits the connecting tube fastened to the microscope eyepiece. Others interpose a beam-splitter or mirror between the microscope eyepiece and the film so that the image can be projected on a groundglass or into a telescopic viewer for focusing and framing. The choice between the different photomicrographic adapters for the 35 mm cameras will depend on the particular application which may be desired.

This miniature has been fitted to a microscope by a special attachment that allows focusing directly on the groundglass after the camera lens is removed.

The selection of film and filters will depend, of course, on the specimen being photomicrographed. Finegrain film is preferable. Positive or color-blind film may be used with many slides, and its extreme finegrain qualities and higher inherent contrast are frequently beneficial. With stained slides, or when filters are required, the very slow-speed panchromatic film designed for copying is suggested. If living specimens are to be photomicrographed, the slow or medium-speed panchromatic films used for general

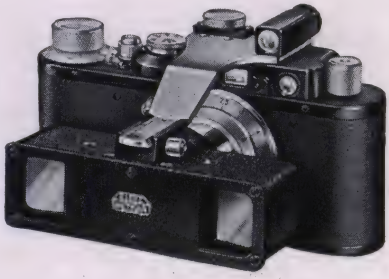


AMMOPHILIA, by R. W. St. Clair, is typical of the pictures that can be made through a microscope with the aid of attachments.
Taken with a Contax through a microscope, focusing by reflex-mirror attachment, using blue filter, on Perutz Pergrano film, 1/25 second.

photographic work may be required. The advantage of standardization would suggest the use of only one type of the slow-speed panchromatic film for all photomicrographic work, especially for the occasional worker in this field. With stained slides, and to control contrast and detail, the use of filters is required. It is well to bear in mind that a filter the same color as the slide will enhance detail at the expense of contrast while a filter of the complementary color will do the opposite. Exposure in photomicrography is somewhat of a problem. Some investigation on the use of photoelectric meters has been done, but there is still a lot to do in this direction. If a record is kept of the variables and standardization is followed as far as possible, experience will soon prove a fair guide as to what the exposure should be.

Stereo Photography.

Although change in the size of objects as their distance from the camera varies, or aerial perspective caused by a loss of contrast and shading in the distance, will give an element of depth to a picture, this is an illusion. A photograph actually gives the same view that would be seen with one eye. For the real depth as seen by two eyes, called binocular vision, two pictures—each taken from a different viewpoint—must be viewed separately but simultaneously by each eye. These are called **stereograms,** and the making of such pictures is called **stereo photography.** The viewer used so that the two pictures can be seen separately and simultaneously by each eye is called a **stereoscope.** Because of depth of field, camera size, separation between the two lenses, and convenience in viewing, stereo cameras are usually of the miniature type.



This miniature is equipped with a stereographic attachment for making three-dimensional photos.

Subjects in which there is no motion can be photographed with the usual single-lens miniature, the camera being moved the proper distance between exposure of the two pictures. This is called the **interocular distance**—the distance between the two eyes—which is about 2½ inches or from 6 to 6.5 cm. This shifting is done more easily with a bar containing a sliding piece, the bar being fastened to the tripod and the camera being attached to the sliding piece. The bar has an index mark at each end, the distance between being the same as the interocular distance. The stereo negatives are obtained by making an exposure with the camera fastened at one

GRAPES, by Dana Mitchell, is an excellent still-life made with close-up attachments.
Taken with a Contax with *f* 2.8 lens, and supplementary lens and Contameter; 4 seconds at *f* 22 by artificial light.

index mark, then sliding it along the bar and fastening it in position for exposure at the other index mark. Two cameras fastened together can also be used if the lenses are not more than 2½ inches apart. A special stereo camera with matched lenses, and shutters, and interlocked lens diaphragms will be even better and more convenient. With two cameras fastened together or a special stereo camera, stereo pictures can be made of moving as well as still subjects.

Since the image is reversed and upside down in the camera, the two pictures will be transposed when printed. This means that the prints must be cut apart, the right-hand print being mounted to the left and vice versa. If the negatives are cut apart after development, they are easily identified because in the left-hand view foreground objects will be more to the right in respect to background objects than in the right-hand view. Stereo pictures (or

JAVELIN THROWER, by Frank Sunderland, A.R.P.S., shows the application of filters for contrast and dramatization of sports subjects.
Taken with a Contax with *f* 1.5 lens through an orange filter on Panatomic film, 1/50 second exposure at *f* 8.

stereograms) should be viewed in a stereoscope with lenses having approximately the same focal length as the camera lens. If the sterograms are enlarged, the stereoscope lenses should have a focal length the same number of times longer than the camera lens as the amount of linear enlargement.

Accessories that permit the two stereo negatives to be made simultaneously with the standard lens are available for miniature cameras. The two separate views are produced on the area of a single negative by means of prisms or mirrors spaced the correct distance apart, each view being passed through one-half the lens. In taking, these negatives are transposed as well as reversed and upside down, and transposition is not necessary in printing. Contact prints or transparent positives can be made, then viewed through a stereoscope or special transparency viewer. Direct-color film can be used without any difficulty whatsoever. Stereo projection on a screen—in either black-and-white or color—is easily possible with polarizing screens and polarizing eyeglasses. The same prism or mirror device is placed over the projector lens, polarizing screens being adjusted over the two openings so that their planes of polarization are at right angles to each other. The two projected views are seen separately by each eye when the viewers wear polarizing spectacles in which the planes of polarization are likewise at right angles to each other. The result, especially if the projected view is in color, is startling in its remarkably lifelike fidelity.

CHAPTER VI

MINIATURE FILM AND ITS EXPOSURE

The Kinds of Miniature Film.

Negative materials differ greatly in speed, inherent contrast, and color sensitivity. Speed is a measure of the sensitivity of film to the light reflected from the subject. With a given light intensity, the exposure required to secure a negative of correct density and contrast is determined by the film speed. Since speed and exposure vary inversely, the fast films will require less exposure than the slow ones. The speed of any film is not a constant, due to the unequal sensitivity of film to the different colors, and it will vary with the color charactetristics of the light source.

While subject contrast and development control negative contrast, the applicability of a film to a subject will be determined by its inherent contrast. The very fast films are generally of low inherent contrast, the contrast increasing as the speed of the film becomes slower. Orthochromatic films generally are more contrasty than panchromatic films of the same speed. The so-called noncolor-sensitive, or color-blind, films are very sensitive to blue and relatively insensitive to all the other colors. Orthochromatic film is sensitized to green as well as blue, but it is still more sensitive to the blue than to the green. Panchromatic film is sensitized to all colors, but—as with the orthochromatic—there is still an excess of sensitivity to the blue.

One manufacturer has classified panchromatic film in three general groups: Type A, called regular panchromatic; Type B, called orthopanchromatic; and Type C, called hyperpanchromatic. Although the first is sensitive to all colors, there is a marked lack of sensitivity to a portion of the green. The second has a high general

sensitivity to all colors closely approximating that of the average human eye. The third is sensitized to all colors with an extreme sensitivity in the red. All three types, however, have a greater sensitivity to the blue than to any other color. This unequal sensitivity to colors can be counterbalanced by filters to render colors in the subject in black-and-white tones that approximate visual sensitivity. With Type B film, on account of its excess sensitivity to blue, the blue-absorbing yellow filter will be used for visual correction. The Type C film, with its extreme sensitivity in the red in addition to excess blue sensitivity, requires the yellow-green or light green filter, absorbing some red as well as blue, for the same effect. Reference should be made to the instructions that ac-

This picture by Dr. Ernst Schwarz is a striking example of the pictorial possibilities of infrared film with its extreme contrasts.

Taken with a Leica through a dark red filter on infrared film; 1/40 second exposure at *f* 3.5.

company the film as to its type, color sensitivity, and filter factors.

The miniature user should not overlook the possibilities of infrared film. It can be used for pictorial purposes as well as for specialized applications in aerial, medical, scientific, and industrial, photography. While the 35 mm infrared film is readily obtainable, the cut film and roll film must be ordered from the manufacturer through your dealer. Infrared is an invisible radiation, similar to the visible radiation known as light, which is found in the spectrum beyond the red. Since the film, as with all color-sensitized film, is sensitive to blue as well, a blue-absorbing filter such as the orange or light red must be used if the infrared effect is to be secured. The film is also sensitive to the extreme red, and an infrared filter will be needed for some applications. For all practical purposes, however, the blue-absorbing filter will suffice. No safelight can be used in the darkroom with infrared film. Otherwise no special precautions are required with a modern miniature. Older cameras, though, should be checked to make sure that their bellows, shutters, film-holder slides and other parts are entirely opaque to infrared radiations. Very striking pictorial effects are easily achieved by the use of this type of film.

Natural color films are a distinct contribution to miniature photography. One brand is made in two types in both the cut film and 35 mm sizes. One in each size is balanced for use with average sunlight. In the 35 mm size, the other is adjusted for floodlamps as a light source but may be used with tungsten bulbs as well. The second type in the cut-film size is adjusted for lighting with high-efficiency tungsten lamps. Filters are available so that the 35 mm daylight film can be used with electric light, or vice versa, and the tungsten-type cut film can be used with daylight. There are also a variety of haze and other filters for special effects. Direct-color films, however, should not be used with regular filters, employed in black-and-white work—only with the filters especially designed for them.

CLOWN, by A. Molind, illustrates the importance of having some natural action to enliven a photograph, even a character shot.

Taken with a Contax with *f* 1.5 lens at 1/250 second at *f* 8.

The Selection of Miniature Film.

In the sense that all following operations depend on it, the negative can be considered the basis of all photography. For best technical results, therefore, the characteristics of a film under varying circumstances and with different subjects must be known. Selection of the correct film for a particular purpose will be a bewildering problem, and few miniature workers will find it possible to learn the characteristics of all films. Some are designed for definite purposes; others can be applied successfully in all general photographic work. The best procedure, therefore, is to standardize on the general all-purpose film of one manufacturer. Then, when its possibilities are known, that film will serve as a comparison for more specialized films or the general all-purpose films of other manufacturers. Standardization will not be easy though. The film manufacturers' advertisements are as alluring as their products are excellent. Nevertheless, switching from film to film in search of one that has every desireable feature is both fruitless and expensive. Learn one film well before you use any others.

The best general all-purpose film is a medium-speed Type B panchromatic film. This is the type having a high general sensitivity to all colors, closely approximating that of the normal eye. Its advantages for standardization are many. The medium yellow filter required for visual correction has a low factor. The film speed is fast enough for fairly high shutter speeds and small apertures with average daylight intensity. Indoors, with two medium-size floodlamps, shutter speeds of 1/25 or 1/50 second are possible with an *f* 2.8 diaphragm setting and the lights within six to ten feet of the subject. The grain of medium-speed film is such that ten to fifteen times enlargements can be made easily. The grain will not be as fine with faster film. Slower-speed film will have even less grain, but its speed is such that instantaneous exposures cannot be made with many commonly-encountered lighting conditions. Therefore, the recommendation that a medium-speed Type B panchromatic film be

adopted as standard for all general photographic purposes at the start.

The high-speed films should only be used when necessary. They have a higher degree of graininess, but this is not so evident with poorly-illuminated subjects. With tungsten or flood illumination, the Type C panchromatic is better because of its extreme red-sensitivity. Except for rapid action, however, there is no reason for using the very fast films with good daylight illumination outdoors. No advantage is gained, and there is a very definite loss in quality on account of the increased graininess. Where the illumination is exceptionally good or where extreme enlargements are to be made, the slow-speed, finegrain films are best. In fact, if outdoor photography in the daytime is the only application of your miniature, this is the film on which to standardize. Of ample speed for such purposes, its extremely fine grain makes tremendous enlargements easily possible. The very slow films are best used for copy and closeup work. With black-and-white line sketches and drawings, etc., the non-color-sensitive, or color-blind, positive film is best because of its exceptionally high inherent contrast. If colors in the subject are to be differentiated or filters must be used, very slow panchromatic films are used. Orthochromatic film is the choice of many workers for outdoor subjects. Used with tungsten or floodlight sources in the portraiture of men it will give very strong effects. It is also valuable with landscapes where strong aerial perspective or atmospheric effects are desired.

The Importance of Exposure.

Although each step in the photographic process has a part in the technical quality of the print, exposure of the negative is the most important. While error in any of the following steps generally can be compensated or the work can be done over, errors in exposure can never be fully compensated and frequently are irreparable. If the subject cannot be rephotographed, the result is a total loss.

In a correctly-exposed black-and-white negative, the

darkest shadows in the subject will be just scarcely veiled with silver. There will be detail in both the highlights and shadows, and the scale of tones will have good gradation throughout without compression of tones in either the highlights or shadows. If of an average-contrast subject, the negative will print on a normal enlarging paper, then the exposure and development have both been correct. If the negative is thin and flat but has detail and a full tone scale, the exposure was correct and the negative has been underdeveloped. If it is very dense with detail and a full tone scale, exposure was likewise correct, but the negative has been overdeveloped. While correct exposure is generally desirable, deliberate underexposure or overexposure can be used to lose detail and compress the tones in either the highlights or shadows.

Accuracy in exposure of the negative is of paramount importance. The cost of a good exposure meter and the time spent in learing how to use it will be repaid many times over in the saving of wasted film and lost time. Many people will tell you that film latitude will take care of exposure errors; others will claim that such errors can be corrected when making the enlargement. Do not rely too much on these nebulous possibilities. There will always be a loss when an error in exposure exceeds the latitude of the film. With average subjects and most films this will be twice or one-half correct exposure. Few can guess exposure to within that accuracy. An exposure meter is not a sign of weakness. Practically all advanced photographers, both amateur and professional, own and use them today.

How to Use an Exposure Meter.

In the use of a meter it is well to remember that exposure is the product of the light intensity reaching the film times the length of time for which it is allowed to act. The length of time that the light is allowed to act on the film is controlled by the shutter speed. The light intensity reaching the film is regulated by the lens diaphragm. The diaphragm setting, or *f*-number, is the ratio between the

PAUSE IN THE FOG, by George F. Hull, shows particularly good rendition of fog, even though taken under very difficult conditions. Taken with a Contax with *f* 1.5 lens used wide open at ½ second.

diameter of the lens aperture and its distance from the film. Therefore, each setting of the diaphragm is a constant regardless of the focal length of the lens. The same amount of light from the subject will be admitted to the film at an aperture of *f* 4 with a lens of 3.5 cm, 5 cm, 8.5 cm, or any other focal length. The amount of light passed by the lens varies inversely as the square of the *f*-number. Diaphragm settings marked on the lens mount follow one of two systems generally:

Continental system—*f* 1.6, *f* 2.3, *f* 3.2, *f* 4.5, *f* 6.3, *f* 9, *f* 12.5, *f* 18, *f* 25, *f* 36.

English system—*f* 1.4, *f* 2, *f* 2.8, *f* 4, *f* 5.6, *f* 8, *f* 11, *f* 16, *f* 22, *f* 32.

With each system the amount of light passed by any *f*-number is twice that of the next higher *f*-number, and one-half that of the next lower. Practically all of the lenses used in this country are marked in the English system, and in some ways it is the more preferable of the two.

The first operation in the use of an exposure meter is to adjust it for the speed of film being used. If the meter is of the fixed film-speed type this cannot be done, and the proper allowance in exposure must be made for the film being used. If it is faster than the film used, the exposure must be decreased by that amount; if slower, that amount of increase must be allowed. Some meters of this type are provided with calculators with which the amount of increase or decrease can be translated instantly into the correct shutter speed and *f*-number for the film being used. If not, such a table should be drawn up, then attached to the meter or carried in the kit bag for ready reference. Most of the extinction-type and the real direct-reading and calculator-type photoelectric meters are easily adjusted for the speed of film being used. The speed ratings of the various films for any meter generally are given with the instructions accompanying the meter. If not, they can be secured from the meter manufacturer or dealer.

In taking a general reading of any scene from the

camera position, the photoelectric exposure meter should be pointed slightly down so that only a small part of the sky will be included in the reading. Because of the ready adaptation of the eye to different conditions, the light value in an extinction-type meter should be determined within a few seconds after the instrument is placed to the eye. If not, the meter should be removed from the eye for a minute, then replaced. Otherwise, as will be seen by holding such a meter at the eye for a minute, a light value greater than correct for the light intensity will be obtained, resulting in underexposure. When an extinction-type meter is used in very brilliant light, such as snow or the seashore, the eyes should be closed or shielded for a minute before taking the reading.

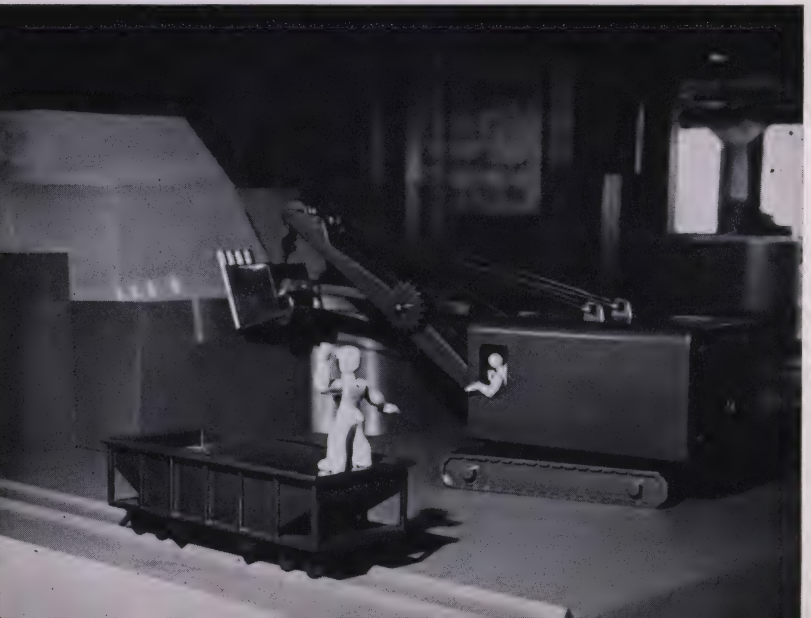
If the subject is of normal contrast, the reading obtained by pointing the meter directly at the subject from the camera position will be correct. When such a reading of the entire scene is made of other than normal-contrast subjects, allowance should be made in the exposure indicated by the meter. With low-contrast subjects, or subjects of high-contrast in which the darker portions are to be silhouetted, the exposure should be one-half that indicated by the meter. Subjects having a great range of contrast should be given twice the exposure indicated by the meter. When some specific object in the scene is of importance, the reading should be taken directly from that object. In doing so, the meter should be brought so close to the object that its field of view—generally given in the instruction book—just covers the object itself. Then correct exposure for the range of tones in that object will be obtained.

The most accurate method of securing correct exposure with any meter is by taking a reading on the brightest and darkest parts of the subject, then averaging the exposure between the two readings. Because of its limited latitude, allowing for little error in exposure, this has proved the most satisfactory method with natural color film. It can be used with either the calculator or direct-reading type of photoelectric meter as well as with

extinction-type meters. With direct-color film, the reading should be taken from the brightest and darkest colors without regard for any white or black objects in the scene. Averaging of the light intensity is most convenient with the calculator-type photoelectric meters, since the light intensity can be averaged before calculating the correct shutter-speed and diaphragm settings. With the direct-reading-type photoelectric meters and the extinction-type meters, the shutter-speed setting of both the darkest and brightest object is read at the **same** diaphragm settings. The two shutter-speed settings are then averaged for the correct average shutter speed with that diaphragm setting.

Model for Ford World's Fair Exhibit, by R. W. St. Clair, shows the use of the miniature in record and tabletop photography.

Taken with a Contax with *f*2 lens, 1/25 second at *f*8, with artificial light.



CHAPTER VII

YOUR MINIATURE IN USE

The Adjustment of Its Controls.

To secure maximum efficiency from your miniature, regardless of its cost or type, the operation of its controls must become so familiar as to be performed almost mechanically. No matter how automatic its operation there are certain adjustments that must be made before taking a picture—generally just at the very instant when the picture itself demands the utmost concentration. Then, unless the miniature's controls can be set correctly without conscious thought, practically all of your attention will be given to the camera rather than the subject. The familiarity that will prevent this trouble is best gained by going through all the operations involved in loading the miniature, taking a picture, then unloading it. Do this over and over again until all the operations can almost be performed without looking. With such practice the intelligent use and efficient operation of any miniature becomes easy.

Before doing this, however, read the instruction book that came with your miniature. Contrary to general opinion, it is not designed to confuse the purchaser nor to be put away until some difficulty arises that cannot be solved by pulling, pushing, and turning every lever in sight. A great deal of time and money has gone into making that instruction book as concise, explicit, and comprehensive as possible. It should be read carefully with the camera at hand for constant reference. Then go through each operation described until you are thoroughly familiar with it. Next spend an evening going through all the operations, over and over again, involved in taking a picture—right from exposure-meter reading to advancing the film for the next picture—without film in

the camera. It won't be long before operation of the controls will become second nature, a familiarity that will pay dividends many times over when you are really out taking pictures.

The Basic Operations.

There are three basic operations with any camera: loading, taking the picture, and unloading. Each resolves itself into several steps that should be systematized. Since all miniatures differ in some respects, the procedure suggested in the instruction book should be adopted.

Opening the miniature is a relatively simple matter, yet not infrequently excellent instruments are damaged by improper handling at this stage. Your camera is carefully built, and it should open smoothly and easily. If it sticks for some reason, don't try to force it. Instead, get out the instruction book and check your efforts step by step. Practice this operation until it is fixed firmly in your mind. Loading the miniature with film is fully described in the instruction book, but a few points will bear emphasis. If it is of the 35 mm. type, make certain that the sprocket teeth are fully engaged in the holes along each edge of the film. With roll-film miniatures, turn the film-wind knob once or twice to make certain that the film is feeding correctly and lies flat across the back of the aperture plate. If you use a filmpack, pull the tab so that the light-protective lip is not opened momentarily. The back of the camera should close easily after loading. If it sticks, do not force it. Open it up again and find out what the trouble is. If you can't, take the film out and perform the whole operation again with particular care. And above all, **do not load your miniature in direct sunlight.**

If you have practiced the steps carefully as suggested in the previous section, the taking of your first picture with a new miniature will not occasion any particular difficulty. Assuming the camera to be loaded and open, the following procedure will be advisable:

DREAMY ST. WOLFGANG, by Joseph M. Bing, F.R.P.S., shows the successful seizure of a chance to combine the pictorial with human interest.

Taken with a Makina with *f* 2.9 lens on panchromatic film.

1. Determine the exposure and decide on the most advantageous combination of diaphragm and shutter-speed settings for that exposure.
2. Adjust the diaphragm and shutter-speed controls to the proper settings.
3. a. Cock the shutter if necessary.
   b. Pull the dark slide if your miniature is of the plate-and-filmpack type.
   c. If your miniature has both a between-the-lens and focal-plane shutter, make sure that the shutter not being used is open.
4. Focus by scale or by rangefinder or groundglass.
5. Release the shutter.
6. Wind the film on for the next exposure. With a plate-and-filmpack miniature, replace the dark slide immediately after the exposure.

There will, of course, be variations with different miniatures, but a routine very similar to the above will be found most efficient. Once it is learned, the operation of the miniature becomes almost automatic.

The diaphragm and shutter-speed controls should be adjusted before focusing the camera. With those miniatures having helical-focusing mounts, adjustment of the diaphragm setting after focusing will frequently throw the lens focus out. Additionally, the light intensity is more likely to remain constant than the position of the subject. Once the diaphragm and shutter are set the lens can be focused, the subject framed in the viewfinder, and the shutter released almost simultaneously with many miniatures.

When the last exposure has been made, the film must be wound through, or rewound so it can be removed from the camera. Roll film, of course, is wound forward until the paper trailer is entirely on the take-up spool. With those 35 mm miniatures taking daylight-loading spools with paper leader and trailer strips or two bulk-film magazines, the same procedure is followed. With other 35 mm miniatures, the film must be rewound onto the supply spool. Be careful not to advance the film beyond

the last exposure with this type or it will be torn off the supply spool. Then the camera will have to be taken into the darkroom for unloading. Filmpacks can be removed from the adapter as soon as the last tab has been pulled; be careful, however, not to press in the face of the pack, for then light will leak around the edges. Cut film and plates, if not developed immediately on removal from the holders, should be replaced in the original package with the black protective paper between them as when originally packed.

Cleanliness Pays Dividends.

Cleanliness is necessary in all photographic procedures, but the camera, lens, and accessories must be clean if the precision and accuracy built into your miniature are to produce technically good results. The brilliance and definition of a good lens are easily spoiled by a film of dust or grease on the lens surfaces. One piece of dust or sand inside the camera can cause a scratch that will run the entire length of the film. Film chips from careless loading can find their way into a focal-plane shutter and stop its action entirely. Dust or grease on the range-finder windows will make focusing difficult and inaccurate. Dirt and dust can cause a host of other troubles and should be fought incessantly.

Every serious miniature owner should have a physician's rubber ear syringe, a supply of fine lens tissue, and a camel hair brush. The ear syringe will be used to blow dust off the lens and out of the camera, the tissue to remove grease marks and other dirt from the lens and other glass surfaces, and the camel hair brush to remove specks that cannot be reached or dislodged with a blast of air from the ear syringe. Never touch the lens surfaces or other glass with your fingers or anything other than the lens tissue or camel hair brush. Do not put liquids or any other preparations on your lens. If any marks on the lens or other glass surfaces cannot be removed by blowing gently across the surface or rubbing gently with lens tissue, send the lens to the manufacturer for

cleaning. Do not take the lens apart. If there is any foreign matter inside, its removal should be left to the manufacturer. Never oil or grease any part of the camera. The failure to observe all these "don'ts" keeps many camera repairmen busy.

Clean your miniature thoroughly before using it. First examine the lens surfaces front and back. Blow off any dust with the ear syringe. If this does not remove all the dirt, blow on the lens and rub it gently with a piece of lens tissue. Then use the syringe to blow off the lint from the tissue. If any dust remains, flick it gently away with the camel hair brush. Next, blow out the inside of the camera. Make sure the interior of the bellows is free from dust. Then take a piece of lens tissue and rub it gently over the aperture plate and rollers to remove any grease, dust, or gelatin. Now give a final blow or two with the syringe, load the camera, and close the back. If you happen to get a finger mark or other dirt on the lens and have no lens tissue, an old, well-washed linen handkerchief can be used in place of the tissue. Do not use a silk handkerchief, for it can scratch badly.

Keep your camera clean at all times, but do not go beyond the steps mentioned. If there is anything wrong in any other way, return the camera or lens to the manufacturer for necessary repairs. It is wise to return a camera to the manufacturer every twelve to twenty-four months, depending on how extensively it is used, in order to have it completely checked and overhauled. The mechanism in your miniature is in many respects similar to that in a watch. Give it the same treatment you would give a watch.

Taking the Picture.

If you have heeded the foregoing and learned how to handle your camera and operate its controls, taking the picture will be comparatively easy. While the miniature is held more easily than the large camera, the greater enlargement of its smaller negatives necessitates greater steadiness. This is no hardship, for the greater speed and

depth of field of the miniature's lens permit the use of higher shutter speeds. Whenever possible, hand-held exposures should be made at shutter speeds of 1/100 second or faster. If necessary, shutter speeds as slow as 1/25 second or longer can be made with the camera held in the hand. Certain tripod substitutes will be useful when working at such slow shutter speeds, but a good tripod is the most dependable.

The direction of subject motion in relation to the direction in which the camera is pointed will have a bearing on the shutter speed necessary to stop it. The speed of motion will naturally play a part as will the distance of the subject from the camera and the focal length of the lens. Subjects moving directly across the field will require the highest shutter speed. Those moving obliquely across the field of view at an angle of 45 degrees can be given 50% longer exposure. If the subject is moving directly away from or toward the camera, three times the exposure

The method of holding the camera will vary with its type and the wishes of the photographer, but regardless of method it must be steady. The method illustrated braces the camera securely on the forehead.

that would stop motion in a subject moving directly across the field is permissible. Tables giving the shutter speed required to stop motion with various subjects will be found in most photographic handbooks.*

When you have used your miniature for a while, elementary disturbing factors will no longer trouble you. Then the subject of composition, concerning which many books have been written and experts have argued heatedly, will begin to be of interest. As in writing or any other creative work, composition is the arranging of the elements in the picture so it will have unity, coherence, emphasis, and variety. This is achieved through the placement of masses, tones, and lines in the picture area. Good composition is not consistently easy of attainment without some understanding of its basic principles, but it is not the terribly complex and involved thing that some photographers make of it. Study the pictures of other photographers, analyze them to find the elements that make you like or dislike them, then read about the basic principles of composition.

What to Photograph?

Picture-making opportunities with your miniature will be limited only by your interests, vision, and conception. There is no occupation, avocation, or subject to which the the miniature cannot be applied. Its scope is as wide and varied as life itself. So the answer to the question will be found within yourself. Your picture-making interests will generally follow your regular interests and concentrate themselves on those things you like and understand best.

Think your pictures out ahead of time. Study the prints afterward to see if you got the full possibilities out of your subject. Analyze the picture for its defects, study out how to overcome them, then go back and take the picture over again. Maybe the sun was at the wrong angle. Perhaps a different viewpoint would give better perspective and angle. Another season or different weather conditions might make all the difference in the world. A

*This subject is discussed fully in *Photographing Action*, (Little Technical Library, No. 14). See page 119 in this book. Ed.

PERSIAN QUEEN, by A. S. Mawhinney, is an outstanding high-key picture made with a miniature camera, and hung in very many exhibitions. Taken with a Leica G with *f* 4 lens on Panatomic film by artificial light.

figure in the foreground of a landscape or architectural shot will frequently save an otherwise ordinary picture. Every scene has picture possibilities, but they are very seldom going to be caught effectively with the first exposure.

How to Progress More Rapidly.

If you are a really active and intensely interested photographer, membership in a live-wire camera club will be a tremendous advantage. The clubs sponsor lectures on technical and pictorial subjects, competitions, outings, and other activities that provide a stimulus to better work. They provide darkroom facilities, have classes for beginners, and give demonstrations in portraiture and lighting. If you are not interested in club activities and prefer to work alone, you will find a wealth of information in the various books and magazines.

But, whatever you do, make yourself a program. It does not have to be arduous nor do you have to stick to it. Our photography, after all, is to be a pleasure and a relaxation. But a program will not keep us from enjoying it. First, decide what interests you most. Then go ahead. Don't talk photography, practice it. But practice it with a plan and not hit-or-miss.

CHAPTER VIII

THE MINIATURE DARKROOM

The Basic Requisites.

Any specific plans or layouts for miniature darkrooms presented in this limited space would be rather useless because of the varying requirements, equipment, and available space of different miniature owners. More likely than not what suits me perfectly will neither fit your space nor desires. The preferences of another fellow probably will be quite a bit different from the set-up that is just right for you. The specific arrangement of your miniature darkroom, therefore, is best laid out so it will fit your own available space and requirements.

All darkrooms are basically the same, whether for miniature or larger size processing. They must exclude white light and be free from dirt and dust. Running water is desirable but not essential. A uniform temperature will ease the labor considerably. There should be a dust-free and chemical-free atmosphere for winding bulk film, loading cartridges and film holders, and for loading the tank. In these operations there is a danger of film markings due to static electricity. Friction in handling must be avoided. The dry chemicals should not be stored in the darkroom. These should be kept and mixed elsewhere, when possible. Scratches and dust on small negatives ruin prints enlarged to any considerable degree and the main thing to keep in mind in building the miniature darkroom is to exclude dust and dirt.

The arrangement of the work tables and sink can be best figured out by drawing the darkroom on paper to a scale of one or two inches to the foot. The furnishings are then drawn to the same scale on another piece of paper, cut out, and moved around on the scale drawing of the darkroom until the best and most convenient arrange-

ment is found. Try to get everything so located that there will be the least amount of walking around to get things done. The enlarging table is best placed across from the table on which the printing trays will be placed. Then you can turn around immediately after exposing a print and dunk it in the developer without any unnecessary walking. You can rest assured that any time spent in securing the best arrangement for efficiency and convenience in the darkroom will be more than repaid in time saved while working in it. Plan your procedure ahead of time, then make your arrangement fit that plan as closely as your space and equipment permit.

Safety Always.

Amateur darkrooms are notoriously deficient as far as electrical safety and the health of the worker are con-

This photograph shows the author's darkroom, which is probably more complete and elaborate than many cameramen will feel necessary.

cerned. Fresh air is vital, yet most darkrooms are so efficiently sealed against light that the entrance of fresh air is impossible. Further, the solutions and chemicals used in photography are hazardous. Light-traps for ventilation are easily built and some photo-supply houses have them ready-made for a nominal sum.

All darkroom wiring should be done in accordance with the rules of the National Electrical Code and the National Electrical Safety Code. The first is designed for protection against fire; the second looks to the safety of those using electricity. The requirements of both are reasonable and sensible, being drawn from many years' experience with fires and loss of life caused by unsafe electrical equipment. The proximity of water pipes and dampness to electrical equipment and wiring should be guarded against in every way possible.

If you make the kitchen or bathroom your darkroom, do not store chemicals or solutions in the ice box, medicine chest, or any other closet or space used by others. If you have a darkroom, keep it locked when you are not in it. The poisons, such as potassium cyanide or mercuric chloride, or the strong acids or alkalis, must be kept locked in a special closet and the bottles marked. With children in the family, failure to observe these rules may have tragic consequences. Poisons, strong acids, and strong alkalis are not used in any of the more common processes. If their use is required for special process, buy a very small quantity and dispose of the chemicals and solutions as soon as possible. Safety always, not safety first, should be the motto in the darkroom and in the handling and storage of chemicals and solutions.

CHAPTER IX

DEVELOPING MINIATURE FILM

Finish Your Own Film.

When the miniature first became popular, there was no commercial service providing the finegrain development required with such tiny negatives. The miniature user, therefore, was required to do his own developing and enlarging to secure satisfactory results. Today this is no longer true and many finishers develop finegrain negatives. However, few photofinishers, compelled to work on production schedules, can hope to equal the quality turned out by the capable amateur with no time limitations. Ordinary developing and enlarging involve no special complications, and a serious effort to learn the few required steps will be rewarded with success in a remarkably short time.

The Developer.

There are a number of excellent developer formulas. Many of them vary only slightly; others have widely differing characteristics. The few given herein will serve for most purposes. If none of these formulas satisfy, many others can be found in any good photographic handbook.* Do not change from one developer to another without reasons. Given the right type of developer for the purpose, faulty procedure or method is more likely to be the cause of unsatisfactory results than the developer.

The oldest finegrain developer still generally used was originated by the Eastman Research Laboratories almost fifteen years ago. It is usually recommended for use only with the larger miniature negatives that are not to be enlarged to any great extent.

*This subject is discussed fully in *Darkroom Handbook and Formulary*, (Little Technical Library, No. 20). See page 119 in this book. Ed.

SPEED BOAT, by Cleve Le Blanc, is a well-balanced action shot made by carefully cropping the full negative; note the strong highlights.

Taken with a Super Ikonta B with *f* 2.8 lens; 1/400 second at *f* 5.6.

Eastman D-76.

Water (125° F. or 52° C.)	750 cc.	24 fl. oz.
Metol	2 grams	30 grains
Sodium Sulfite (Anhydrous)	100 grams	3⅓ ounces
Hydroquinone	5 grams	75 grains
Borax	2 grams	30 grains
Water to make	1000 cc.	32 ounces

D-76 is an excellent developer, which does not cause any loss in film speed. Negatives developed in it should be capable of from eight to ten times enlargement without grain becoming readily apparent. It is easily mixed and keeps well. The negatives are clean with good gradation in tones from highlight to shadow. There are many variations derived from the basic formula given, and many film manufacturers recommend a developer of this type for use with some of their films.

Extreme enlargement, of negatives developed in D-76, however, shows grain. The first satisfactory paraphenylenediamine developer, worked out by Dr. Sease of The DuPont Film Manufacturing Corporation, gives negatives of finer grain.

Sease No. 3.

Water (125° F. or 52° C.)	975 cc.	31 fl. oz.
Sodium Sulfite (Anhydrous)	90 grams	3 ounces
Paraphenylenediamine (free base)	10 grams	150 grains
Glycin	6 grams	90 grains
Water to make	1000 cc.	32 ounces

Negatives developed in Sease No. 3 should stand enlargement to twenty-five or thirty-five times. The contrast, unlike some finegrain developers, is excellent. The tone gradation is not so good, and detail sometimes is lacking in the middle tones. It is only recommended for use when extreme enlargements are to be made from miniature negatives. There is a loss of one-half the normal film speed when it is used, requiring twice the exposure needed with the same film when developed in D-76.

A good all-round developer which I have used extensively over the last six years is derived from Sease No. 3.

It has good gradation, fairly fine grain, and excellent contrast. In addition, it is easily mixed and keeps well.

Edwal 12.

Water	1000 cc.	32 fl. oz.
Metol	6 grams	90 grains
Sodium Sulfite (Anhydrous)	90 grams	3 ounces
Paraphenylenediamine (free base)	10 grams	150 grains
Glycin	5 grams	75 grains

A similar formula by Dr. E. W. Lowe, the originator of Edwal 12, will give even finer grain with somewhat the same characteristics as Edwal 12 except for some loss in the effective film speed:

Edwal 20.

Water	1000 cc.	32 ounces
Gradol	5 grams	75 grains
Sodium Sulfite (Anhydrous)	90 grams	3 ounces
Paraphenylenediamine (free base)	10 grams	150 grains
Glycin	5 grams	75 grains

Neither of these developers works as well with the first roll or two as it does with subsequent rolls. For this reason, the usual recommendation is that about 20% of the old used developer be added to the new before it is used. If preferred, a strip of undeveloped film can be exposed to light so as to fog it, then be left in the new developer for twenty minutes to season it before use in lieu of adding the old developer.

Another excellent developer of somewhat similar characteristics has been originated by Le Roy Roselieve.

Fink-Roselieve X-33.

Diotol	8 grams	120 grains
Metol	5.5 grams	82 grains
Sodium Sulfite (Anhydrous)	78 grams	2¾ ounces
Glycin	1.5 grams	22 grains
Tri-basic Sodium Phosphate (Anhydrous)	3 grams	45 grains
Potassium Bromide	0.5 grams	7½ grains
Water to make	1000 cc.	32 ounces

X-33 is a fine all-round developer for miniature work. The negatives developed in it have excellent quality and will stand many times enlargement.

At night the contrast range of the subject is usually extremely long, resulting in either blocking of the highlights or loss of detail in the shadows. For such subjects the developer originated by M. U. Wallach, noted for his night and stage pictures, is excellent.

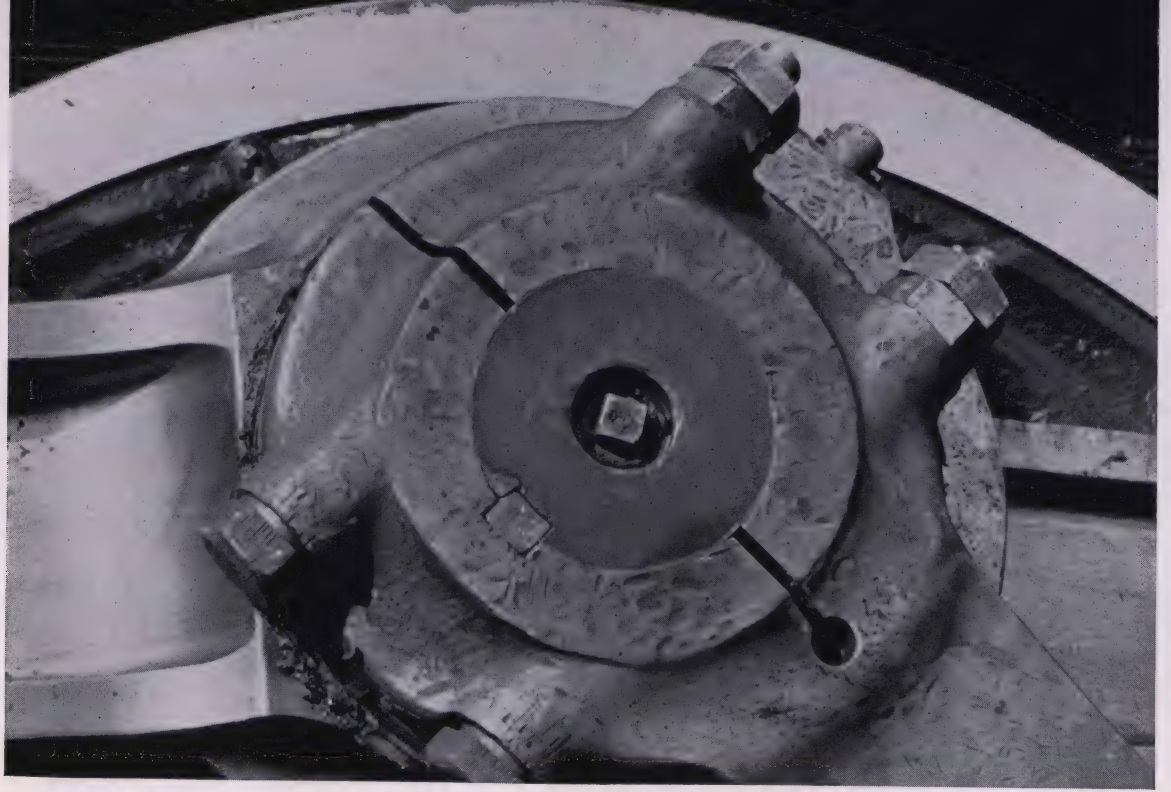
Wallach W-80.

Metol	6 grams	90 grains
Sodium Sulfite (Anhydrous)	75 grams	2½ ounces
Paraphenylenediamine Hydrochloride	10 grams	150 grains
Glycin	5 grams	75 grains
Pyro	1 gram	15 grains
Tri-basic Sodium Phosphate (Monohydrated)	2 grams	30 grains
Water to make	1000 cc.	32 ounces

While this developer can be used with other subjects, it is especially recommended for theater photography and night work outdoors.

Selecting the Developer.

Negative size and the character of the photographic work are the determining factors in developer selection. At the start, while getting the feel of things, use one good all-round developer until you know its capabilities. Give a developer every chance before discarding it for another. If it is satisfactory, don't change with the first rumor of a new, marvelous "magic soup." Never forget that every developer is a compromise as regards desirable characteristics. Fine grain is highly desirable, but it must not be secured at the expense of effective film speed or good tone gradation. D-76 is an excellent developer, but its finegrain characteristics are not as desirable as those of the other developers mentioned in certain cases. With Edwal 12 and Fink-Roselieve X-33 the loss in effective film speed is so slight that film latitude will generally take care of it. The finegrain qualities of Sease No. 3 are excellent,



LOCOMOTIVE WRIST-PIN, by Charles C. Munro, illustrates the adaptability of the miniature to the rendition of detail.
Taken with a Contax with *f* 2.8 lens on Panatomic film; 1/50 second at *f* 8.

but the film speed will be reduced to one-half its normal rating and the tone gradation of the negative is not so good. Edwal 20 will likewise require almost twice the normal exposure (i.e., the film-speed rating for film developed in it is only little more than one-half normal). but the tone gradation will be excellent. It is a good developer to use for negatives taken outdoors where film speed is not essential.

Remember, too, that the grain characteristics of the film itself play a part in the final result. The faster films will all tend to have a coarser grain than the slower films. A slow, finegrain film developed in a finegrain developer will yield the finest grain possible. If a higher film speed is necessary, use faster film and develop it in a finegrain developer. With poor lighting conditions and a maximum of film speed necessary, use the fastest film and a developer causing no loss in effective film speed. Do not attempt to secure maximum finegrain at the expense of other characteristics that are sometimes more desirable. Best all-round results will be secured with a medium-speed panchromatic film and a good finegrain developer.

Mixing the Developer.

The general procedure for mixing a developer solution is as follows:

1. Heat about two-thirds the required amount of water to 125°F. Exactness of temperature is not necessary, but it should not be any higher.
2. Add the chemicals in the order given in the formula, making sure that each is entirely dissolved before the next is added. **Always** add the chemical **slowly** to the water. Do not stir so vigorously as to force air into the water.
3. After the last chemical is entirely dissolved, add enough cold water to make the required amount of solution.
4. Using the funnel and filter paper or absorbent cotton, filter the solution into the bottle. Make sure it is corked tightly.

This procedure should be followed unless other instructions are given with the formula.

Water purity is just as important as that of the chemicals used in making the solutions. Tap water will generally be satisfactory. Tap water, however, in some localities is so "hard" (i.e., contains a great quantity of dissolved mineral salts) that the use of distilled water will be necessary for best results. Some workers use it for all solutions regardless, believing that it is poor economy to buy the finest chemicals without equal care as to their water supply for solutions. This procedure is not always necessary. Consultation with your local water company will soon provide the answer as to whether your tap water will be satisfactory for photographic solutions.

The Short-Stop and Hardener.

After development and before fixation, the film should be placed in a short-stop and hardening bath for three minutes. While in this bath it must be continuously agitated. This bath stops development instantly and aids in lengthening the life of the fixing bath. In addition, it hardens the gelatin so as to prevent undue absorption of water during the following processes—sometimes a cause of grain and reticulation.

Short-Stop and Hardener Solution.

Chrome Alum	**20 grams**	**300 grains**
Sodium Bisulfite	**20 grams**	**300 grains**
Water to make	**1000 cc.**	**32 ounces**

The chemicals should be added in the order given, and each should be entirely dissolved before the next is added. This solution will not retain its hardening qualities for any great length of time. It should be discarded as soon as you are through working, and a new solution mixed the next time you develop film. A large quantity of film can be hardened in it over a short time, but the solution should be thrown away when it loses color or a scum forms on it. But, even if the scum has not formed, it does not retain its hardening qualities overnight.

The Fixing Bath.

The following acid hardening fixing bath, originated by the Eastman Research Laboratory, is recommended for use with all films.

Acid Hardening Fixing Bath—F-5.

Water (about 125° F.)	600	cc.	20 ounces
Sodium Thiosulfate (Hypo)	240	grams	8 ounces
Sodium Sulfite (Desiccated)	15	grams	½ ounce
Acetic Acid (28%)	48	cc.	1½ ounces
Boric Acid (Crystals)	7.5	grams	¼ ounce
Potassium Alum	15	grams	½ ounce
Cold water to make	1000	cc.	32 ounces

Again dissolve each chemical entirely before the next is added. The acetic acid should be added slowly, and the solution should be stirred thoroughly while it is being added. Be sure to use the crystalline boric acid; the powdered form is dissolved with great difficulty.

The Equipment.

A tank is an essential. Short lengths of roll film can be developed in a tray by the see-saw method, but this is a drudgery. Pack and cut film can be developed in a tray but not as uniformly and correctly as in a tank which keeps the solutions at a uniform temperature. The bakelite tanks are efficient and the least expensive, but may break when dropped; stainless steel tanks overcome this objection. Some tanks are more easily loaded than others; this point should be kept in mind when purchasing.

Tanks for 35 mm film have either aprons in which the film is wound or reels provided with grooves in which the film slides. Personal likes determine the choice; some people have difficulty in keeping the apron from touching the film at certain points, which prevents the developer from reaching some areas. Some reels are difficult to load and it is advisable to practice with a roll of film even if it has to be wasted. Always keep the tank clean, washing it before and after using, and drying it thoroughly before attempting to load it.

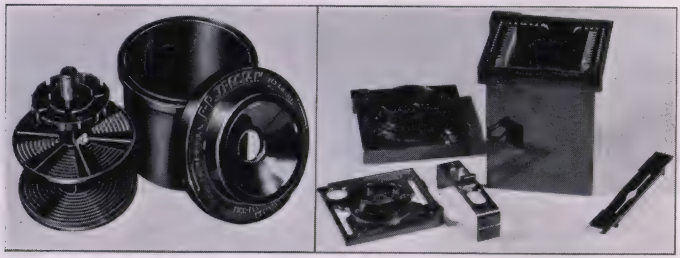
The importance of keeping all solutions at the same

BUTTONS, by Dr. J. M. Freston, is an informal portrait such as is easily taken with the miniature camera with its high-speed lens.

Taken with a Contax with *f* 1.5 lens on Finopan film; 1/100 second at *f* 1.5.

temperature cannot be overemphasized. An accurate thermometer is a necessity. Its scale should be graduated from about 50° to 90°F. The type known as a developing tank thermometer will be most convenient.

Two film clips to use in hanging the film while drying



Developing tanks for roll film (left) and cut film or plates (right).

are needed, one to hang the film and the other to act as a weight. Use a viscose sponge to remove the surface water, thus preventing water spots, before the film is hung up to dry. There are other aids you can get, but they are not absolutely necessary. An agitator will eliminate the necessity of agitating the film by hand every minute or two. When an efficient continuous agitator is used the time of development should be decreased about 30% for the same amount of development. A film drier will assure speedier drying and keep dust from settling on the film while drying.

The Basic Requisites for Fine Grain.

Never forget the fact that the basic elements of fine-grain finishing are cleanliness, care, and the maintenance of uniform solution temperatures. Clean tanks, utensils, and solutions; agitation at frequent and uniform intervals; hardening and fixation—these are regarded as the basic requirements by all good miniature workers. Cleanliness and care should always be a matter of routine. A good water bath to keep the temperature of all solutions constant can be made in the darkroom or kitchen sink with

a rubber stopper. Fill the sink to the proper height with water at the desired temperature, which varies with different developers but is normally 65 to 70 degrees. Then place all the solution bottles and tank in the water. The solutions will soon be brought to the desired temperature for development, and this temperature is then easily maintained during processing.

Density and Contrast.

To the emulsion chemist density is the logarithm of opacity. The practical miniature worker, though, will regard density as the light-absorbing capacity of the negative. Those parts having high density, representing the highlights in the subject, will print light since more of the printing light is absorbed by the negative. Those having low density, representing the shadows in the subject, will print dark since more of the printing light will be transmitted by the negative. If the range in density between the highlight and shadow portions is long, the negative is called **hard** or **contrasty.** If this range is short, the negative is called **flat** or **soft.** If the range is medium, the negative is called **normal.** This range in density from the highlight to the shadow portions of the negative is called the **negative contrast.**

Exposure primarily controls overall density, greater overall density being obtained with more exposure. All other factors remaining the same providing the latitude of the film is not exceeded, increasing or decreasing the exposure will increase or decrease the overall density but the range in density from the highlight to the shadow portions of the negative will remain the same. If the exposure is increased beyond the latitude of the film, the highlight tones will be flattened or compressed. If it is decreased beyond film latitude, the shadow tones will be flattened or compressed. While the type of developer used will have some effect on the overall density—some developers producing denser silver deposits with the same exposure—exposure is the primary factor controlling overall negative density.

The negative contrast, or the range in density from the highlight to the shadow portions of the negative, is determined by the subject contrast, the type developer used, and the amount of development the negative receives. Subject contrast itself cannot always be controlled by the photographer. Some developers are hard or soft working, and these will be selected in some instances to correct for subjects having an unduly long or short range of contrasts, or when some special effect is desired. With stage or outdoor night shots, the contrast range of the subject generally being very long, a soft-working developer such as W-80 will sometimes be used to compensate. In copying manuscripts or black-and-white line drawings, a hard-working developer may be used to give a maximum of contrast in the negative. For most subjects the normal developers will be used, and sufficient control can be maintained over negative contrast, when necessary, by varying the amount of development.

An increase in the amount of development will increase the negative contrast; a decrease in the amount of development will decrease it. This knowledge is useful in two respects. First, with very contrasty subjects, the negative contrast can be lessened by reducing the amount of development; with subjects lacking contrast the negative contrast can be made greater, adding "snap" to the picture, by increasing the amount of development. Second, the information is useful in fitting the contrast to a particular type or kind of paper. For instance, a picture taken on a dull or rainy day will lack "snap." Increasing the time of development will add to the contrast and thus give more "snap" to the print. In such cases, it would be well to reduce the exposure by about 25% so that there would be no possibility of blocking the highlights with the increased development. Conversely, the extreme contrast in a street scene, shaded by buildings on one side with the sun shining brilliantly on the other, can be reduced by decreasing the amount of development. In this case, it would be well to increase the exposure by

about 50% in order to make sure of getting detail in the shadows. Control of contrast should not be tried at first, but when you have gained some experience with exposure and development, a knowledge of the relationship between them and the control possible will frequently be helpful.

Time and Temperature.

Development is controlled by the temperature of the developer solution and the length of time the film is left in the solution, as well as by its chemical make-up. Time and temperature vary directly in their effect, an increase in either with the other remaining fixed resulting in increased development and a decrease in either with the other remaining fixed resulting in decreased development. Since, however, best results are obtained with the tem-

SUMMER SPORT . . . . This picture by R. I. Boone, while of the snapshot type, approaches high pictorial standards through its most excellent technical quality.

Taken with a Contax with *f* 2 lens; 1/1250 second exposure at *f* 2.

perature of the developer not lower than 65° nor higher than 70° F., control of negative contrast is best obtained by varying the time of development. There are exceptions to this rule, as will be mentioned later, but with most developers the finest grain and best results will be obtained within this temperature range.

Since negative contrast is controlled by the amount of development, and the latter is dependent on the temperature of the developer solution and the time that the film is left in it, development must proceed for a specific time at a specific temperature if consistent results are to be obtained. Further, since the inherent contrast of various films differs, different films will require varying times of development at the same temperature for the same effect. These variables, calculated for normal miniature negative contrast, will be found in the following tables

SH - - - - - , by Harry Lott. This excellent child study shows how the proper perspective can be combined with a large negative image by use of a telephoto lens.

Taken with a Contax and *f* 2, 8.5 cm lens; 1/50 second at stop *f* 5.6 on Panatomic-X film.

computed by Le Roy Roselieve* for the developers mentioned earlier in this chapter.

Development Time and Temperature Tables

Temperature in degrees Fahrenheit and time in minutes.

Developer	Temperature	Film Classifications			
		I	II	III	IV
Eastman D-76	65°	12	14	17	19
	70°	9½	11¼	14	16
	75°	7	8½	11	13
Sease No. 3	65°	16	19	21	24
	70°	13	16	18	21
	75°	10	13	15	18
Edwal 12	65°	15	17	19	22
	70°	13	14	16	19
	75°	10	11	13	16
Edwal 20	65°	16	18	20	23
	70°	13¼	15	17	20
	75°	11½	12	14	17
Fink-Roselieve X-33*	65°	17½	19½	20½	24½
	70°	15	17	18	22
	75°	12½	14½	15½	19½
	80°	10	12	13	17
	85°	7½	9½	10½	14½
Wallach W-80	65°	16½	18	20	24
	70°	14	15½	18	21½
	75°	11½	13	16	19

*The best results with Fink-Roselieve X-33 will be obtained at a developing temperature between 70° and 75°F., and satisfactory results will be secured at a developing temperature up to 85°F. If the temperature is above 75°F., the Short-Stop & Hardener Solution must be used after development. Since the temperature of the fixing bath should not exceed 80°F., it cannot be the same temperature as the other solutions when the developer is above 80°F.

These tables are computed, as stated, for normal miniature negative contrast** based on normal exposure of the films given in the following classifications. If greater

*Director of Research: Fink-Roselieve, New York, N. Y.

**The correct terminology is "gamma," the use of which would introduce complications neither necessary nor desirable at this point. For the benefit of the technically-minded, the information is given that the tables are computed to a gamma of 0.8.

development contrast is desired, the time of development should be increased by 15% to 20%; for less development contrast, decrease the time of development by 15%. With underexposed negatives, provided the degree of underexposure is not too great, an increase in the time of development of between 25% to 30% will result in satisfactory but rather contrasty negatives. These tables are based on film agitation every two minutes.

Film Classifications.

35 mm and Roll Film.

Class I.

Agfa Finopan
DuPont Infra-D
DuPont Superior I
Eastman Infra-Red
Eastman Panatomic-X
Gevaert Microgran

Class II.

Agfa Fine-Grain Plenachrome
Agfa Superpan Supreme
DuPont Superior II
Eastman Plus-X

Class III.

Agfa Super Plenachrome
Eastman Verichrome
Gevaert Express Superchrome
Gevaert Panchromosa

Class IV.

Agfa Ultra-Speed Panchromatic
Eastman Super-XX
DuPont Superior III
Agfa Superpan Press

Cut Films and Filmpacks.

Class II.

Agfa Commercial Panchromatic
Defender Fine Grain Panchromatic
Eastman Commercial Panchromatic
Eastman Par Speed Portrait

Class III.

Agfa Isopan
Agfa Superpan Portrait
Defender Portrait HGS
Defender Pentagon
Defender X-F Ortho
Defender X-F Panchromatic
Eastman Portrait Panchromatic
Eastman S. S. Portrait
Gevaert Studio High Speed
Gevaert Ultra Panchro

Class IV.

Agfa Superpan Press
Agfa Super Plenachrome Press
Eastman Super Panchro-Press
Eastman Tri-X Panchromatic

Development at Higher Temperatures.

This procedure is not recommended. However, frequently the temperature of the solutions cannot be brought below 75°F. Many finegrain developers may be used

PORTRAIT, by Carl Abel, is a splendid piece of miniature portraiture.

Taken with a 4x4 cm Rolleiflex; 1/25 second at *f* 5.6.

satisfactorily at higher temperatures if sodium sulfate (not sulfite) is added to the solution. Dr. Lowe, the originator of Edwal 12 and 20, has suggested that these developers may be used at temperatures up to 85° and 90°F., by the addition of 50 grams (1⅔ ounces) of sodium sulfate (anhydrous) to each liter (32 ounces) of developer solution. The sulfate is added after all the other chemicals are entirely dissolved. The time of development should then be increased about 20% over normal. With sodium sulfate in the developer, the short-stop and hardener bath must be used.

If development is carried on at temperatures over 80°F., make sure the temperature of the fixing bath does not go above that point. These higher temperatures should only be used, however, when conditions are such that the solutions cannot be brought to a lower temperature. The best results will be had with a temperature between 65° and 70°F. for all the developers mentioned herein except Fink-Roselieve X-33 with which a temperature between 70° and 75°F. will give the best results.

The Developing Process.

Film development is best carried out as a series of steps, outlined as follows. With some experience they become a matter of routine and occasion no difficulty:

1. If solutions are not the right temperature, place them in a water bath of that temperature.
2. Load the tank with film to be developed.
3. Pour the developer into the tank, noting the time.
4. Tap the tank against the table three or four times to break loose any air bells that may have formed when the developer was poured in.
5. Agitate the film for about fifteen seconds every two minutes while the developer is in the tank.
6. At the end of the proper time (see the time-temperature tables) pour the developer out of the tank.
7. Pour the short-stop and hardener solution into the tank immediately.
8. Leave the short-stop and hardener solution in the tank for three minutes, **agitating continuously.**
9. Pour out the short-stop and hardener and pour in the acid hardening fixing bath immediately thereafter.

STREET PAVERS, by Dr. Max J. Futterman, shows excellent use of backlighting to deepen shadows and effectively bring out smoke.

Taken with a Super Ikonta B with *f* 2.8 lens on Panatomic film; 1/100 second exposure at *f* 5.6.

10. Leave the acid hardening fixing bath in the tank for fifteen minutes, agitating for about fifteen seconds every two minutes.

11. Pour out the fixing bath and wash the film (still in the tank although the cover may be removed) in running water for thirty minutes.

12. Remove the film from the tank and hang it up to dry.

13. Wipe the surplus water off each side of the film with a damp (not dry) viscose sponge.

14. When the film is dry, roll it with the emulsion side **out** and allow it to stay that way for a few days. The film will then be flat when cut apart for filing.

Negative Handling and Storage.

The negatives that are good enough for you to keep deserve the best of care. They should not be handled any more than necessary, and then only by the edges. Negatives should be filed in envelopes according to some easily-used system that will enable you to find them when they are needed. Some workers file them in rolls, but the preferable method is to cut them apart in short strips. Thirty-five mm negatives are handled and filed easier in strips of six or eight, the larger negative sizes either singly, or two or three together. Cut film and filmpack negatives will have to be filed separately. Strips or single negatives should be filed each in a separate envelope so their surfaces do not rub together—a prolific source of scratches. There are many good filing systems available, and you should ask your dealer to show them to you. The choice, of course, will depend on the particular filing system you wish to adopt. But do take good care of your negatives; many of them will be irreplaceable.

CHAPTER X

MAKING THE PRINT

THE most satisfying, as well as the most interesting of all the photographic processes, printing is also the most important. While the prior processes require care and judgment—for a technically good print cannot be made from a bad negative—they are only steps preliminary to the making of the print, and the print alone is all that matters to others. In it the subject is presented as interpretated by the photographer, an interpretation secured through paper selection, cropping, dodging, toning, and the other printing controls that can make the difference between an ordinary snapshot and a picture of which its

SONG AND DANCE, by M. U. Wallach, illustrates the type of stage photography in which the miniature, with its speed, is unexcelled.

Taken with a Super Ikonta B with *f* 2.8 lens on Superpan film; 1/50 second, wide open lens.

maker will be proud. The requisite ability in printing that makes the difference between flat, muddy, uninteresting prints and those that sparkle with life and feeling is not difficult of attainment. Once that ability is acquired, judgment as to the variables of paper selection, cropping, dodging, toning, etc., comes easily with experience and practice.*

The enlargement of miniature negatives is little different from that of larger negatives. The enlarger should be one built for miniature film, however, and the best you can afford. Those skilled in handling tools can even build their own; photographic literature contains a number of designs.

Before inserting the negative in the carrier be sure that it is free from dust and scratches. Dust can be blown off with an ear syringe or any bulb blower. If you attempt to wipe it off you will create static electricity which will attract more dust. If you blow with your mouth you are likely to deposit moisture on the film.

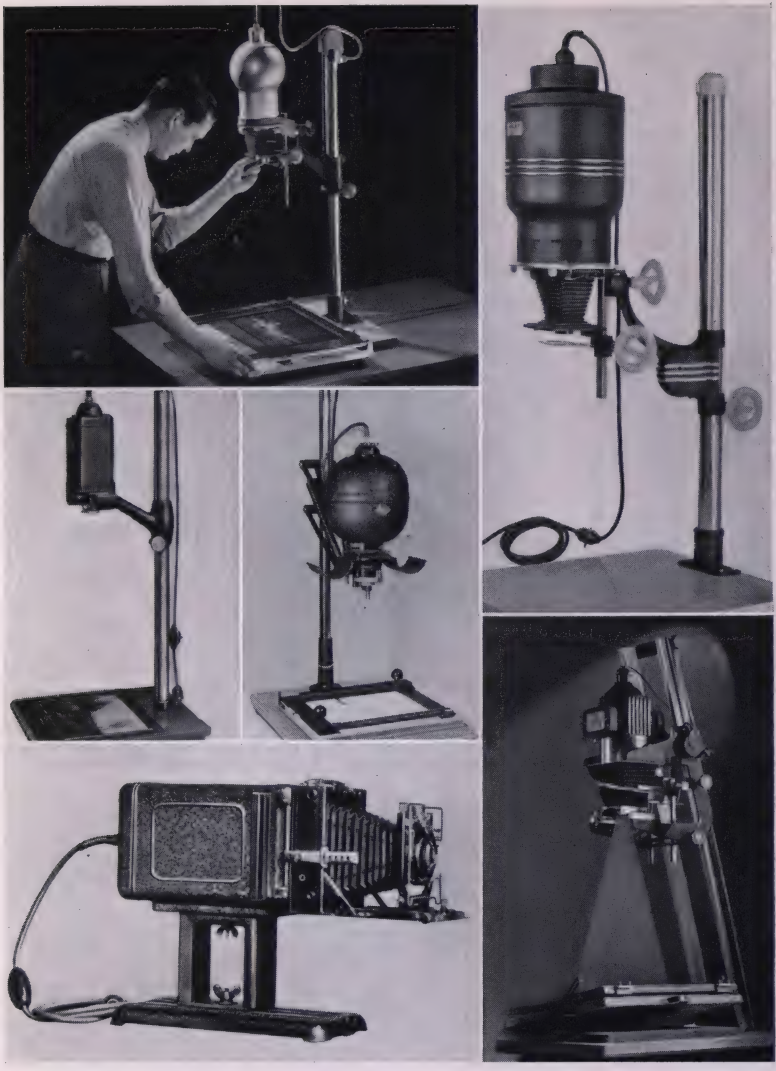
If the film is scratched the scratches will show up in the enlarged print; the larger the print the more apparent the markings. There are several ways to prevent these scratches from printing. The most popular is to make a "glycerin sandwich," pouring a thin film of glycerin on two pieces of lantern slide glass, and sandwiching the negative between them.

If the scratch is only on the back of the film it can be permanently removed by rubbing in jeweler's rouge with a wad of cotton. This must be done carefully and requires some time. Perhaps the best way is to mount the negative permanently between glasses that have been coated on the inside with Canada balsam.

Check again for spots and scratches when focusing the image on the easel. They may be due to flecks of dust on the negative carrier or on the condenser. If so these must be cleaned. Be as careful in cleaning your condenser as you would your lens. Take care not to scratch it or leave finger prints on it.

This precaution of checking for spots is the only

*This subject is discussed fully in *Manual of Enlarging*, (Little Technical Library, No. 15). See page 119 in this book. Ed.



A group of enlargers for miniature camera negatives.

thing that distinguishes miniature enlarging from any other. Persons using the larger size negatives must take these precautions also when they enlarge to the same magnification that miniature workers do.

In making test strips the miniature worker has the advantage of being able to make a print of the whole negative without wasting paper. Three two-times enlargements of a 35 mm negative can be made on one of four strips cut lengthwise from a sheet of 8x10 paper. One can study his composition and map out his dodging as well as decide on the exposure from these. Exposure is determined by multiplying the time of the test exposure by a factor determined by the times of enlargement as carried in the following table:

Exposure Factors at Various Magnifications.

Size of Print	Size of Test Prints		
	Same	Double	Three times
Same size	1	½	¼
Double	2	1	½
Three times	4	2	1
Four times	6	3	1½
Five times	9	4	2
Six times	12	5	3
Seven times	16	7	4
Eight times	20	9	5

If the negative is one inch wide and the short edge of the entire projected image is eight inches, there is an eight times magnification. If your test print was 2x3, or double the size of the negative, the factor will be nine. You will have to expose your print nine times longer than the test print.

Beware of Newton's rings, those colored, oyster shell designs projected on the easel when some part of the film is not flat in the negative carrier. They can be eliminated by putting a mask in the negative carrier.

These are the principal things the miniature worker must pay attention to in enlarging. Sharp focusing on the easel, complete immersion in the developer, use of an acid short-stop bath, and care not to carry the fixing solution to the developer are necessities in all kinds of printing

and need not be discussed in a book on miniature photography.

CONCLUSION

Your miniature opens the way to any and all fields of photography. With its great versatility many of the limitations imposed by the older, larger cameras are ended. Its speed and ease in operation give it such mobility that you can "catch life on the wing," yet it will serve equally well with the most painstakingly arranged still life or the most exacting scientific application. It can serve as your constant companion, always along and always ready yet never a nuisance or obtrusive.

While even the miniature camera imposes a few material limitations, these are not really bothersome and

THE MOVING FINGER

This picture was made by Vincent McGarrett with a folding miniature and a supplementary lens, with the aid of a simple ruler.

Taken with a Super Ikonta A with *f* 3.5 lens; 1 second exposure with iris at *f* 22.

they are easily learned by experience. The greatest limitation in miniature photography will be within yourself. The routine technique of miniature photography given herein may seem complicated and difficult, but taken step by step it is learned with comparative ease. Once it is learned, progress and success will depend on your ability to see picture possibilities about you and your desire to record them on film.

First, the medium—your camera and its accessories—must be mastered to the extent they become known intimately and completely. You must become acquainted with the capabilities of the films, developers, and printing papers used (here simplification and standardization will be important) and know the interrelationship between exposure, development, and printing. But don't let the technique get the better of you as it has with some; master the technique and forget it. Make **pictures** with your miniature.

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